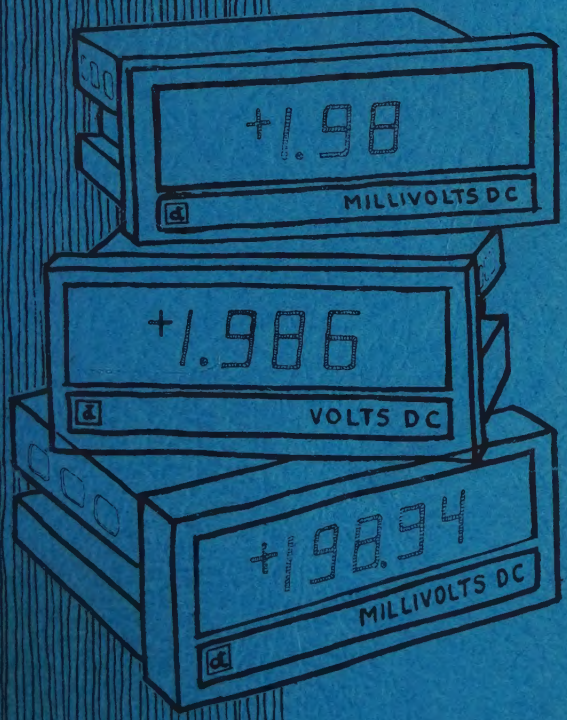
METER ROOM

4½ DIGIT

Panel Instrument

MODELS 4411 and 4412



Instruction Manual

MP MASTER
MA25741

DATA TECHNOLOGY CORPORATION

Instruction Manual

4½ DIGIT

Panel Instrument

MODELS 4411 and 4412

SM2003B P/N 547981

DATA TECHNOLOGY CORPORATION
2700 South Fairview Street, Santa Ana, California 92704

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INTRODUCTION

This technical manual consists of six sections — I, General Description and Specifications, II, Installation and Operation, III, Theory of Operation, IV, Calibration and Troubleshooting, V, Special Modifications, and VI, Drawings and Parts Lists. These sections describe models 4411 and 4412 Digital Panel Meters manufactured by Data Technology Corporation, 2700 South Fairview Street, Santa Ana, California 92704.

The information contained in Sections I and II is normally all that is required for operating the equipment. Sections III, IV, and VI provide data applicable to the equipment's calibration or repair.

Section V of this manual provides detailed descriptions of non-standard or modified assemblies. For modified assemblies, please read this section before operating the equipment.

SECTION I

GENERAL DESCRIPTION AND SPECIFICATIONS

1-1. GENERAL DESCRIPTION

1-2. The Data Technology models 4411 and 4412 are four and one-half digit digital panel meters. The meters are available as voltmeters or ammeters. Any of 22 voltage and current ranges may be specified. See Table 1-1 for model numbers input ranges, and power requirements.

Table 1-1. Model Descriptions

Unipolar Model No.'s	Bipolar Model No.'s	Range	Power Req.
4411-01	4412-01	200mV	115Vrms
4411-02	4412-02	2V	115Vrms
4411-03	4412-03	20V	115Vrms
4411-04	4412-04	200V	115Vrms
4411-05	4412-05	1000V	115Vrms
4411-06	4412-06	2μA	115Vrms
4411-07	4412-07	20μA	115Vrms
4411-08	4412-08	200μA	115Vrms
4411-09	4412-09	2mA	115Vrms
4411-10	4412-10	20mA	115Vrms
4411-11	4412-11	200mA	115Vrms
4411-12	4412-12	200mV	230Vrms
4411-13	4412-13	2V	230Vrms
4411-14	4412-14	20V	230Vrms
4411-15	4412-15	200V	230Vrms
4411-16	4412-16	1000V	230Vrms
4411-17	4412-17	2μA	230Vrms
4411-18	4412-18	20μA	230Vrms
4411-19	4412-19	200μA	230Vrms
4411-20	4412-20	2mA	230Vrms
4411-21	4412-21	20mA	230Vrms
4411-22	4412-22	200mV	230Vrms

1-3. The meter converts the ANALOG INPUT to a digital number and displays that number decimally. The conversion rate is controlled internally at four to six conversions per second; however, an external HOLD control line may be used to terminate conversions. The display continues to indicate the previous reading when the HOLD is activated.

1-4. The conversion technique employed is "dual slope integration." This technique in conjunction with a conversion rate held in sync with the 60 Hz power frequency and an auto zero input amplifier circuit yields a significant degree of noise immunity and accuracy; over a wide temperature range.

1-5. The unit indicates overrange for readings above ±19999 by flashing the most signigicant digit lamp.

1-6. INPUT-OUTPUT FEATURE

1-7. The standard meter is equipped with a connector through which ac power and analog input connections are made. The decimal point is also established via this connector. The digital lines shown in Table 1-2 are available for use in data gathering systems.

Table 1-2. Input Output Lines

Input Line	Output Lines
$\overline{\text{HOLD}}$	POLARITY BCD DATA (17) $\overline{\text{PRINT}}$ COMMAND OVERRANGE

1-8. OPTIONS

1-9. Units with a C2 option include connectors for the meter's J1 and J2. Special modifications are incorporated in models with the suffix -2 added to the model number. See Section V for special modifications.

1-10. SPECIFICATIONS

1-11. See Table 1-3.

Table 1-3. Specifications

GENERAL COMMENTS

Unit is non-blinking readout with flashing overrange.

PHYSICAL CHARACTERISTICS

Size
- Inches ..... 4.787 x 4.05 x 1.8
- Millimeters ..... 121,6 x 102,9 x 47,7

Weight
- Ounces 19
- Grams 538,7

Case Material ..... styrene acrillic butadyene 20% glass filled

Note

Amplifier is allowed to settle for 8-1/3ms (light period). t1-t2 time is completed within 11ms nom (dark period).

ENVIRONMENT

Temperature
- Operating ..... 0 — 60°C
- Storage ..... -10 — +85°C

Humidity ..... 80% max

POWER REQUIREMENTS

115 Volt Option ..... 105 — 125V 60Hz @ 8W
230 Volt Option ..... 195,5 — 253V 50Hz @ 8W

ANALOG INPUT CHARACTERISTICS

Analog inputs are "high" and "low" with analog and digital ground interconnected.

Range	Resolution	Input Impedance (Ω)	Input Bias Current (Max)	Maximum Input W/O Damage	
				Continuous	Instantaneous
±199.99mV	10 μV	10^9	100pA @25°C	250Vdc	550Vdc
±1.9999V	100 μV	10^9	100pA @25°C	250Vdc	550Vdc
±19.999V	1mV	10^7	10pA @25°C	1kVdc	1k Vdc
±199.99V	10mV	10^7	0	1kVdc	1k Vdc
±1000V	100mV	10^7	0	1kVdc	1k Vdc
±199.99nA	10pA	10^6	*±10ppm		
±1.9999μA	100pA	10^5	*±20ppm		
±19.999μA	1nA	10^4	*±20ppm		
±199.99μA	10nA	10^3	*±20ppm		
±1.9999mA	100nA	10^2	*±30ppm		
±19.999mA	1μA	10	*±30ppm		

*Input resistor temperature coefficient per °C.

Table 1-3. Specifications (Continued)

PERFORMANCE

Accuracy

24 hr @ 23°C ..... ±(0.01% rdg +0.01% FS)

90 days @ 25°C ±15°C

200mV and 2V Models ..... ±(0.02% rdg +0.02% FS)

20V, 200V, and 1kV Models ..... ±(0.03% rdg +0.02% FS)

Current Models ..... ±(0.02% rdg +0.02% FS)

Conversion Time (Reset to Print) ..... 19-1/3ms (max)

Settling Time (0V — ±FS) 700ms

Note

Maximum condition is time from CONVERT COMMAND to PRINT COMMAND; t1-t2 time is 11ms (max).

Read Rate

Standard 5/s

Optional (Internal Control) ..... 0.1 — 15/s

Special Option (using $\overline{\text{HOLD}}$ Control) ..... multiples of 16-2/3ms (due to 60Hz sync)

Noise Rejection

NMR ..... 31dB @ 50Hz (2 real poles at input with 12Hz corner freq)

CMR ..... 100dB w/1kΩ unbalance in either input; from 50Hz to 100kHz

CMV (when DATA lines are not used) 500V

DIGITAL I/O LINES

DTL, TTL compatable positive true positive logic levels as follows:

Logic "1" ..... 2.4 — 5.5V

Logic "0" ..... 0 — 0.4V

Output Drive ..... 4 TTL UL or 6.4mA (min)

Input Loading ..... 3.5mA (max)

DATA Lines

17 BCD coded lines + polarity

OVERRANGE

"1" = OVERRANGE

"0" = In Range

$\overline{\text{PRINT}}$ COMMAND

"0" = Valid Data Output Levels

"1" = Unit Converting

Table 1-3. Specifications (Continued)

$\overline{\text{HOLD}}$

"1" (open collector or equiv) = Convert

"0" = Hold Conversions

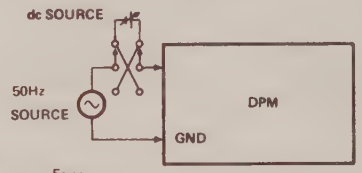
DECIMAL POINT (4)

"0" = Illuminated Decimal Point

Note

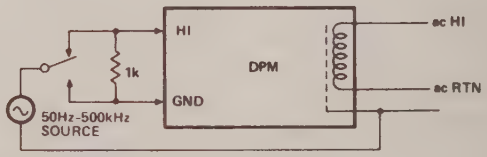
DECIMAL POINT drive circuitry must be able to withstand 80V (OFF condition).

TEST CIRCUITS



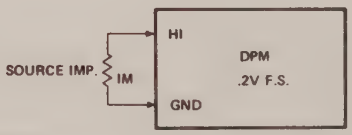
$$\text{NMR dB} = 20 \log \frac{E_{NM}}{E_{IN\ (EFF)}}$$

TEST CIRCUIT FOR NMR



$$\text{CMR dB} = 20 \log \frac{E_{CM}}{E_{IN\ (EFF)}}$$

TEST CIRCUIT FOR CMR



$$\text{INPUT BIAS} = \frac{\text{E READOUT}}{\text{SOURCE IMPEDANCE}}$$

TEST CIRCUIT FOR INPUT BIAS

SECTION II

INSTALLATION AND OPERATION

2-1. INSTALLATION

2-2. Mounting (Figure 2-1)

2-3. The meter may be mounted in a 1.682 ±.010 by 3.924 ±.010 inch panel cutout. To mount, remove the snap-on meter bezel; rotate the pawl screws several turns counter clockwise to retract pawls; insert meter in panel; tighten pawl screws, and replace bezel. See Figure 2-2 for dimensions. Do not obstruct the vent holes on either side of the meter case.

2-4. Wiring

2-5. Any of the following connectors may be used for J1:

Elco-Type 00-6007-030-980-002

Viking-Type 2VK15D2/1-2

Masterite-Type MC15D/1-2

Cinch-Type 251-15-30-160

Data Technology Part No. 531768-007

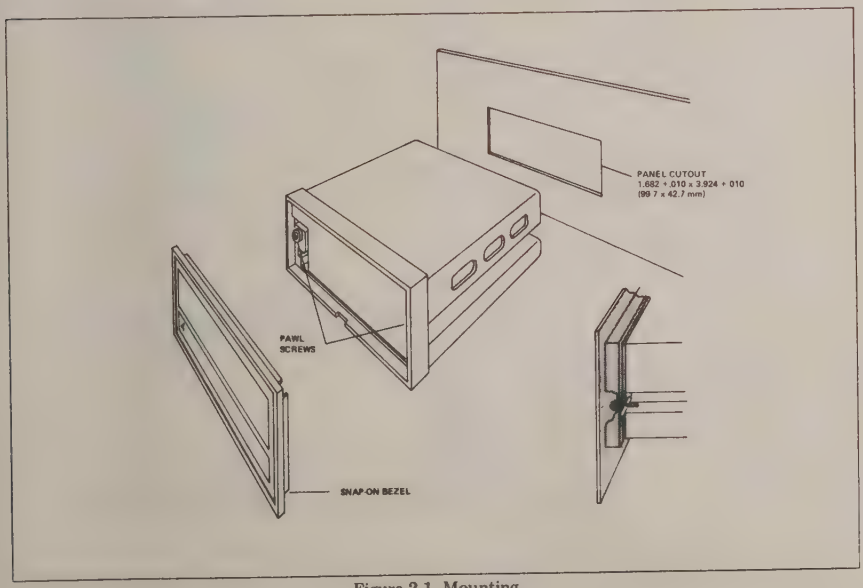


Figure 2-1. Mounting

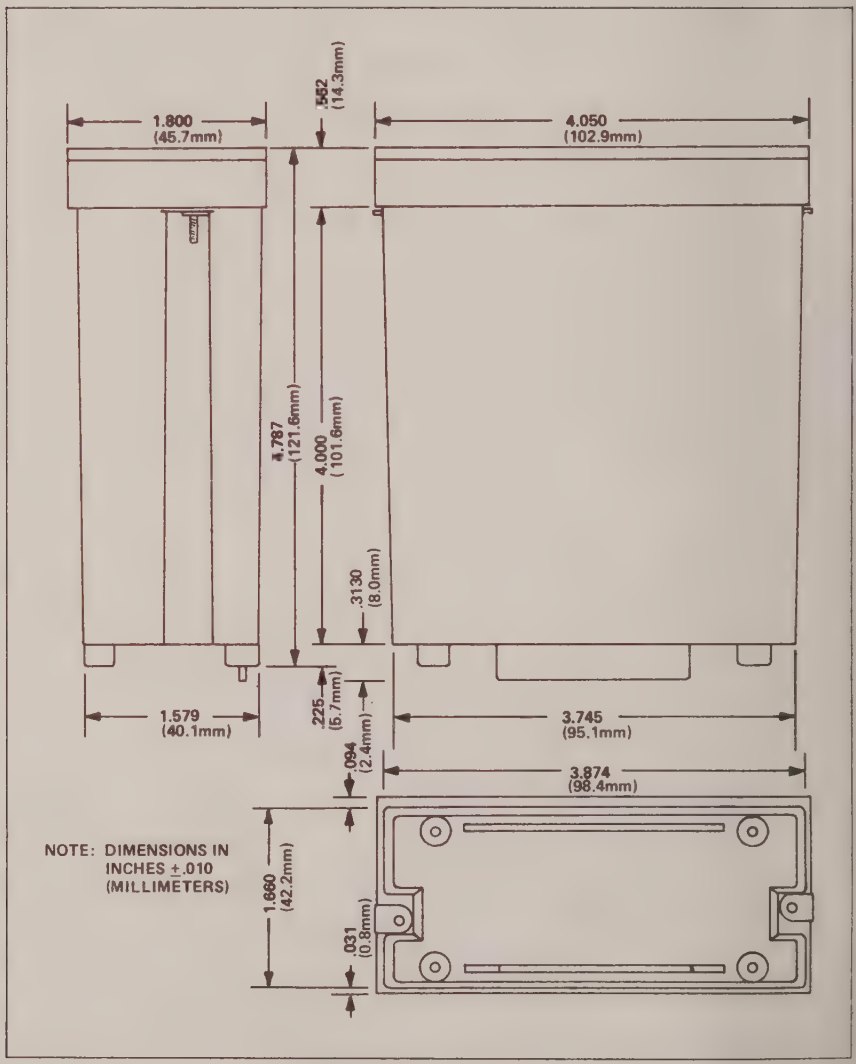


Figure 2-2. Dimensions

2-6. If access to J2's digital input-output lines is required, any of the following connectors may be used:

Elco-Type 00-6007-020-980-002

Viking-Type 2VK10/1-2

Masterite-Type MC10D/1-2

Cinch-Type 251-10-30-160

Data Technology Part No. 531768-006

2-7. These connectors are attachable at the rear of the meter case using the hardware provided. (See Figure 2-3).

2-8. Using Table 2-1, connect 115 volts ac; connect the shield to SYSTEM GROUND; connect the source to be measured between the appropriate ANALOG INPUT and ANALOG GROUND, and, when applicable, establish the decimal point.

2-9. If the meter is used in a darkened environment, do not ground the pin numbers as prescribed in Table 2-1 for decimal point illumination, instead, connect jumpers per Table 2-3.

2-10. If the digital input-output lines are used, refer to Table 2-2 for pin assignments and paragraph 2-10 for operation. If the model number includes a suffix -2, refer to Section V.

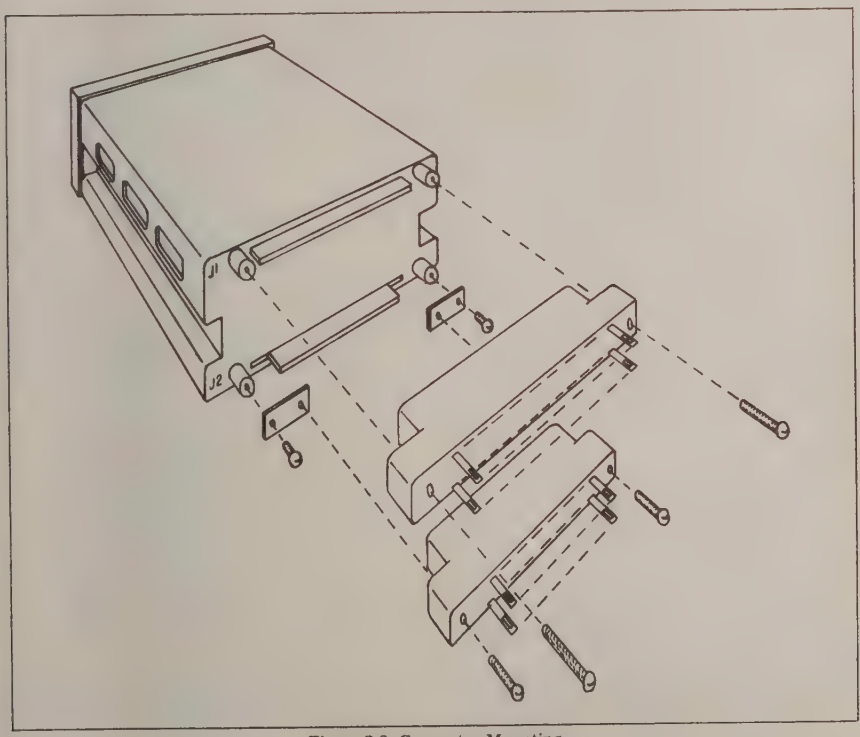


Figure 2-3. Connector Mounting

Table 2-1. Analog Connections

J1 Pin	Signal	J1 Pin	Signal
A	Analog in for 20V, 200V, 1kV meters	1	-15V
B		2	Analog in for 200mV, 2V, and all ammeters
C		3	
D		4	
E	+28V	5	
F	+200pk	6	
H	Display Decimal Point	7	
J	Display Keep-Alive	8	
K	$\overline{\text{HOLD}}$	9	
L	OVERRANGE	10	ANALOG GND
M	+5V	11	GND for Decimal Pt. 1.8888
N	DIGITAL GND	12	GND for Decimal Pt. 18.888
P	+15V	13	GND for Decimal Pt. 188.88
R	SHIELD	14	GND for Decimal Pt. 1888.8
S	115V ac RTN	15	115V ac HI

Table 2-2. Digital Connections

J2 Pin	Signal	J2 Pin	Signal
A	1×10^0 BCD DIGIT	1	4×10^0 BCD DIGIT
B	2×10^0 BCD DIGIT	2	DIGITAL GND
C	1×10^1 BCD DIGIT	3	8×10^0 BCD DIGIT
D	2×10^1 BCD DIGIT	4	4×10^1 BCD DIGIT
E	1×10^2 BCD DIGIT	5	8×10^1 BCD DIGIT
F	$\overline{\text{PRINT}}$	6	4×10^2 BCD DIGIT
H	2×10^2 BCD DIGIT	7	8×10^2 BCD DIGIT
J	1×10^3 BCD DIGIT	8	4×10^3 BCD DIGIT
K	2×10^3 BCD DIGIT	9	8×10^3 BCD DIGIT
L	1×10^4 BCD DIGIT	10	POLARITY (+)

Table 2-3. Decimal Point Jumpers for Dark Environments

Decimal Point	Jumpers
1.8888	J1-H to J1-11 and J1-J to J1-14
18.888	J1-H to J1-12 and J1-J to J1-14
188.88	J1-H to J1-13 and J1-J to J1-14
1888.8	J1-H to J1-14 and J1-J to J1-11
18888	33MΩ from J1-H to J1-14 and J1-10 to J1-11

CAUTION

The dc voltages in Table 2-1 are available at the connector to facilitate flexibility in special situations. These voltages are not intended for use as a source to external systems.

2-11. OPERATION

CAUTION

If the most significant digit lamp flashes, an overrange condition exists. Excessive overrange levels may cause damage to the meter. Remove the ANALOG INPUT and determine that any overrange level is within specified limits. (See Table 1-3).

The models 4411-05 and 4412-05 have maximum ranges of 0 to 1000 and ±1000 volts. No overrange flash occurs at >1000 and ≤1999 volts to warn the user. Do not apply analog levels in excess of 1000 volts.

A flashing most significant digit lamp invalidates the displayed number and BCD data.

2-12. No special instructions are required when the DIGITAL INPUT-OUTPUT lines are not used. The units begin operating upon receipt of the inputs prescribed in paragraph 2-4; if not, refer to the warranty for proper action.

2-13. DIGITAL INPUT-OUTPUT Lines

2-14. The DIGITAL OUTPUT lines are DTL and TTL compatable, with positive true positive logic levels as follows:

"1" = +2.4 to +5.5 volts

"0" = 0 to +0.4 volts

2-15. BCD OUTPUT LINES (17)

2-16. The 17 lines labeled BCD DIGIT provide binary coded decimal logic levels representative of the ANALOG INPUT.

2-17. OVERRANGE OUTPUT LINE

2-18. The OVERRANGE line is a "1" for "off scale" readings (greater than 19999 decimally) and a "0" for "in scale" readings.

2-19. POLARITY (+) OUTPUT LINE

2-20. The POLARITY (+) line is a "1" for positive input levels and a "0" for negative levels.

2-21. $\overline{\text{PRINT}}$ OUTPUT LINE

2-22. The $\overline{\text{PRINT}}$ line is a "0" during the times the other output lines carry valid data and a "1" during times the output lines are changing due to the conversion process. (See Figure 2-4).

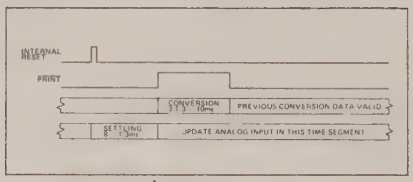


Figure 2-4. $\overline{\text{PRINT}}$ Output Timing

2-23. $\overline{\text{HOLD}}$ INPUT LINE

2-24. A "0" at the $\overline{\text{HOLD}}$ input inhibits conversions. Previous conversion data remains stored and available at the BCD output lines and display when $\overline{\text{HOLD}}$ is made a "0." The next conversion is started about 200 milliseconds after $\overline{\text{HOLD}}$ is returned to a "1."

2-25. For single conversion operation, allow the $\overline{\text{HOLD}}$ line to remain a "1" until the $\overline{\text{PRINT}}$ line goes to a "1." Return the $\overline{\text{HOLD}}$ to a "0" within the following 250 milliseconds to prevent additional conversions. For faster rates, consult Data Technology regarding special modifications.

2-26. The $\overline{\text{HOLD}}$ driving circuitry must be open collector or equivalent. Figure 2-5 shows a $\overline{\text{HOLD}}$ drive circuit which is compatible with DTL and TTL logic levels. Note the inversion.

2-27. DECIMAL POINT INPUTS

2-28. The drive circuitry to the DECIMAL POINT inputs, if used, must be capable of withstanding 80 volts when OFF. This requirement does not cover the dark environment criterion specified in paragraph 2-9.

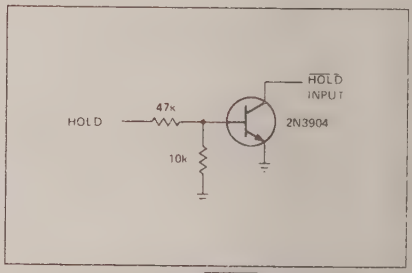


Figure 2-5. Typical $\overline{\text{HOLD}}$ Drive Circuit

SECTION III

THEORY OF OPERATION

3-1. GENERAL DESCRIPTION

3-2. Dual Slope Integration

3-3. The models 4411 and 4412 employ the dual slope integration technique of converting analog levels to digital numbers. See Figure 3-1. The integrating capacitor charges to a level proportional to the ANALOG INPUT during t1 time. During t2 time, the charge current to the capacitor is constant and the reverse of the t1 current, returning the capacitor to the original level. When the original level (zero detect) is reached, the t2 count is entered into the display storage, and the number viewed corresponds to the input level.

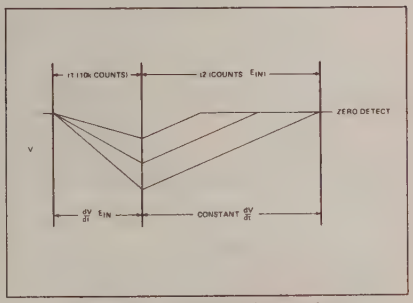


Figure 3-1. Dual Slope Integration

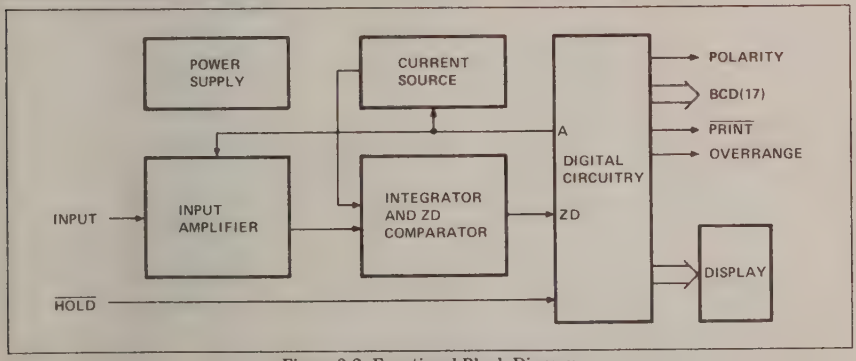


Figure 3-2. Functional Block Diagram

3-4. Functional Block (Figure 3-2)

3-5. The input amplifier is a differentiate and hold circuit, with t1 as hold time. The outputs of the amplifier provide unidirectional current during t1 time and polarity information. During t2 time, the amplifier output is decoupled, and the charge of the integrator capacitor is determined by a current reference. When current from the current reference returns the capacitor to the original level, the integrator and zero detect circuitry transmitts ZERO DETECT (ZD). ZD establishes t2 time.

3-6. The digital circuitry establishes t1 time and conversion rate. The circuitry contains a counter, whose outputs at ZD time are a BCD coded number corresponding to the input level.

3-7. INPUT AMPLIFIER

3-8. The input amplifier is a differentiator between t1 times and switched to a hold circuit during t2 time. See Figure 3-3.

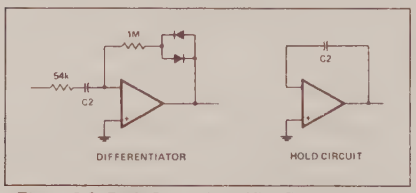


Figure 3-3. Basic Input Amplifier Configurations

3-9. In the differentiator configuration, C2 charges to the input voltage. When the charge is complete, the output of the amplifier is less than plus or minus the diode voltage. In the hold configuration, C2 determines the output voltage. Thus, the differentiator samples the input voltage, and the hold circuit holds that voltage during t2 time.

3-10. Figure 3-4 shows the input amplifier circuitry. Q1 and Q3 are OFF in the differentiate mode and ON in the hold mode. With Q3 ON, diodes CR3 and CR4 are both non-conductive, decoupling R15 from the summing junction. The current gain of the amplifier is controlled by the value of the transconductance (GM) resistor.

3-11. Depending on polarity, either Q6 and Q7 or Q8 and Q9 are conducting. Current through Q8 and Q9 controls the voltage to the non-inverting input of A2 which, in turn, biases Q10 into conduction. Thus, output current is unipolar through either Q6 and Q7 or Q10. R26 is a balance control, so that, like input voltages having opposing polarities produce the same output current. R30 controls the bias to Q10. Q5 senses input polarity. The bandwidth is controlled by R7 and C1 and R8 and C2. CR1 and CR2 are clamps that protect against excessive input voltages.

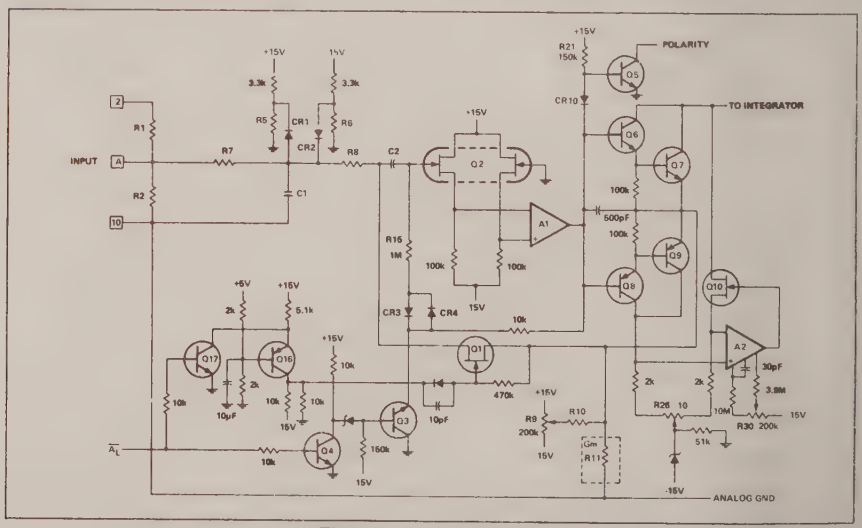


Figure 3-4. Input Amplifier

3-12. The component values which differ with each model are shown in Table 3-1.

3-13. INTEGRATOR COMPARATOR AND CURRENT SOURCE (Figure 3-5)

3-14. During t1 time, "A" is a logical "1," Q12 and Q13 are ON and Q11 is OFF. CR6 and CR8 are non-conductive, and current through CR7 is proportional to the level presented to the input amplifier. Under these circumstances, C9 integrates in the negative direction.

Table 3-1. Attenuator and Gm Values

Range	R1	R2	R5-6	R8	R10	R11	C1	C2	Input
±200mV	open	open	56Ω	56k	2.2M	100Ω	.1μF	.22μF	2
±2V	open	open	560Ω	56k	22M	1k	.1μF	.22μF	2
±20V	9.9M	1.1M	560Ω	560k	22M	1k	.22μF	.022μF	A
±200V	9.9M	100k	560Ω	56k	22M	1k	.047μF	.22μF	A
±1000V	9.9M	10k	560Ω	56k	22M	100Ω	.1μF	.22μF	A
±2μA	open	100k	56Ω	56k	2.2M	100Ω	.047μF	.22μF	2
±20μA	open	10k	56Ω	56k	2.2M	100Ω	.1μF	.22μF	2
±200μA	open	1k	56Ω	56k	2.2M	100Ω	.1μF	.22μF	2
±2mA	open	100Ω	56Ω	56k	2.2M	100Ω	.1μF	.22μF	2
±20mA	open	10Ω	56Ω	56k	2.2M	100Ω	.1μF	.22μF	2
±200mA	open	1Ω	56Ω	56k	2.2M	100Ω	.1μF	.22μF	2

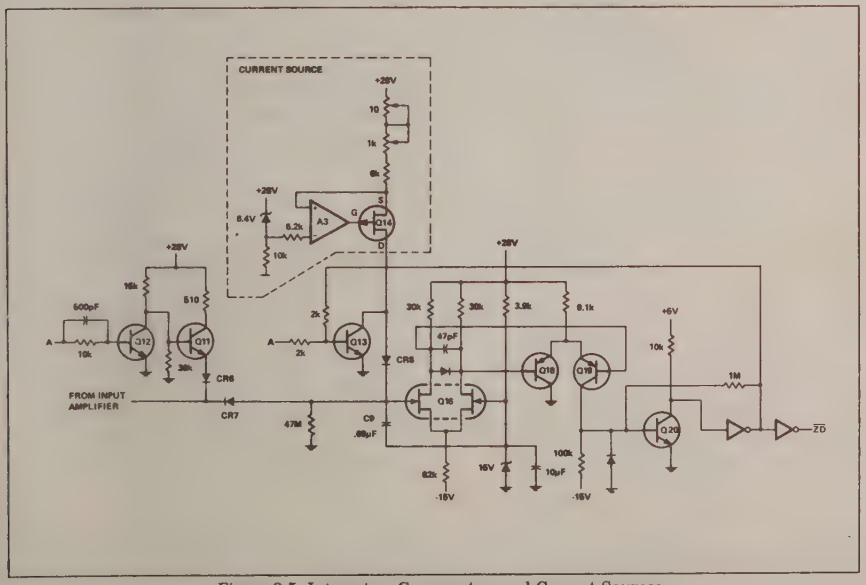


Figure 3-5. Integrator, Comparator, and Current Sources

3-15. When "A" goes to a "0," Q12 and Q13 turn OFF and Q11 turns ON. CR7 is non-conductive, decoupling the input amplifier. Current from the current source now causes C9 to integrate in the positive direction.

3-16. The threshold of the comparator is set at +15 volts. When integration brings the input of the comparator to +15 volts, the comparator changes state transmitting ZERO DETECT (ZD). With ZD, a feedback loop is formed, whereby, the control of the current source by Q13 maintains C9 at the ZD Level.

3-17. The above process repeats when a new conversion is initiated, making "A" a "1."

3-18. DIGITAL CIRCUITRY (Figure 3-6)

3-19. The digital circuitry consists of a counter comprised of four divide-by-ten counters and a divide-by-five counter. Clocking of this counter establishes t1 time, OVERRANGE, and BCD outputs representative of the input level.

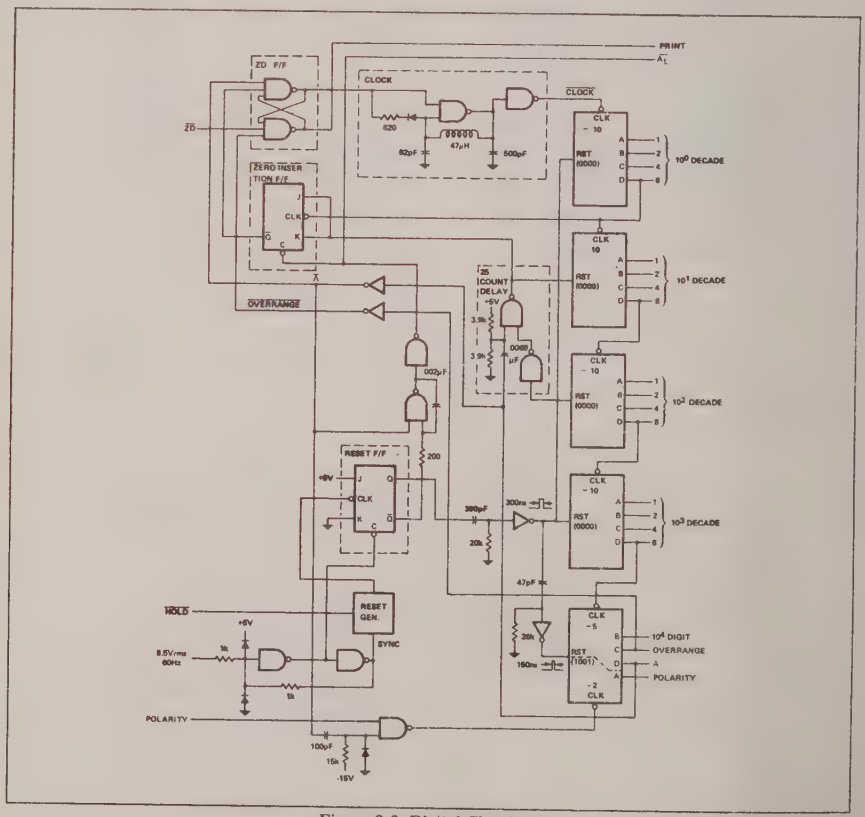


Figure 3-6. Digital Circuitry

3-20. Counter Reset

3-21. The conversion is started when the reset generator emitts a pulse, clocking the reset flip-flop. This pulse is in sync with the zero crossing of the 60 Hz line frequency. Eight and one-third milliseconds later the reset flip-flop is cleared back to the reset state by the 60 Hz sync signal. The "Q" output of the flip-flop drives two cascaded one-shot's that reset the BCD and OVERRANGE outputs to "0's" and the POLARITY and "A" outputs to "1's." See Figure 3-7 for reset timing.

3-22. Counter Clocking

3-23. Basically, the ZD flip-flop enables the clock circuit at reset time and inhibits the clock at ZD time. Actually, the ZD flip-flop may be set by either the "$\overline{A}$" signal or the zero insertion signal and reset by either the $\overline{ZD}$ signal or the $\overline{OVERRANGE}$ signal. These signals as well as the 25-count delay circuit are explained as follows:

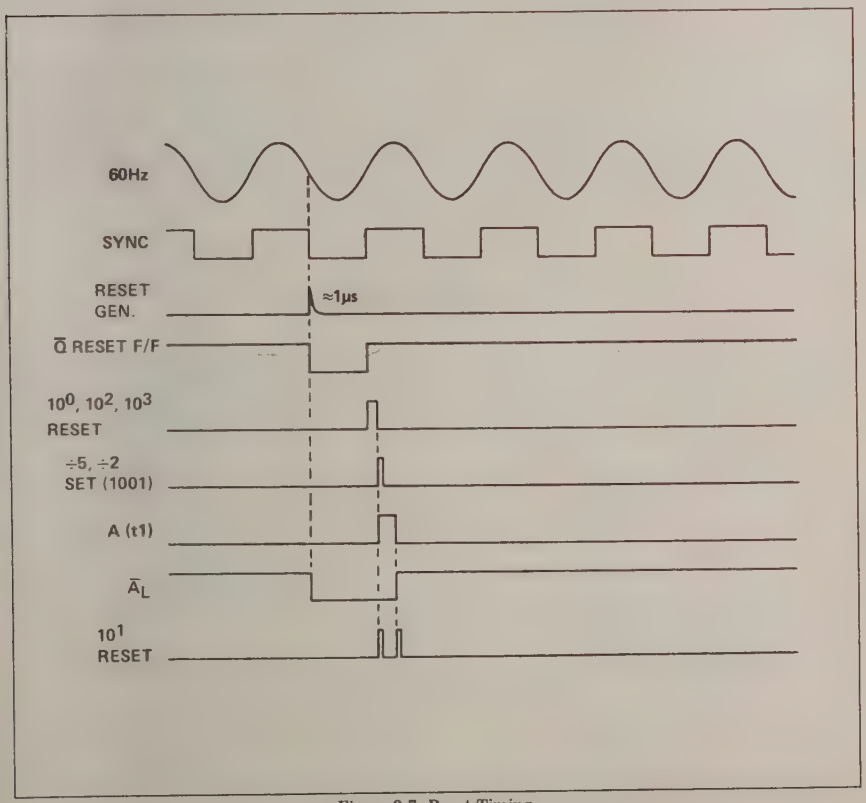


Figure 3-7. Reset Timing

3-24. COUNTER TIMING

3-25. The counter output waveforms shown in Figure 3-8 may be terminated and stored at any point within the t2 range. The termination point is determined by the point ZD occurs. When ZD occurs in the OVERRANGE area, the 10k digit is clocked OFF and the OVERRANGE clocked ON. With the 10k digit clocked ON and OFF flashing of the corresponding light occurs. Since either $\overline{ZD}$ or $\overline{OVERRANGE}$ resets the ZD flip-flop, the clock is inhibited with OVERRANGE.

3-26. 25-COUNT DELAY

3-27. The ZD signal incurs delays due to the bandwidth of the comparator. The delay circuit corrects for these delays by causing the 10^1 decade to be reset through the first 10^1 decade clock. This reset effectively takes 20 counts out of the sequence at the beginning of t2 time. Although 20 counts is more than is necessary, integration current during t2 time is added to provide the complete correction. For example: with a 0-volt input, correction integrator current is added which causes a ZD coincident with 20 counter counts, but, since the 10^1 decade is not clocked, the counter output is all "0's."

3-28. ZERO INSERTION

3-29. To understand zero insertion, imagine what happens when ZD occurs in the 20 counts following t1 time. Terminating the count in this area could yield a readout between 00001 and 00009.

3-30. Although ZD only occurs during this time when a calibration is necessary, a slightly out-of-calibration condition may cause readings difficult to justify near 0-volt inputs. To avoid the resultant confusion, the zero insertion flip-flop forces the clock to remain enabled through the 20 count clock removal time.

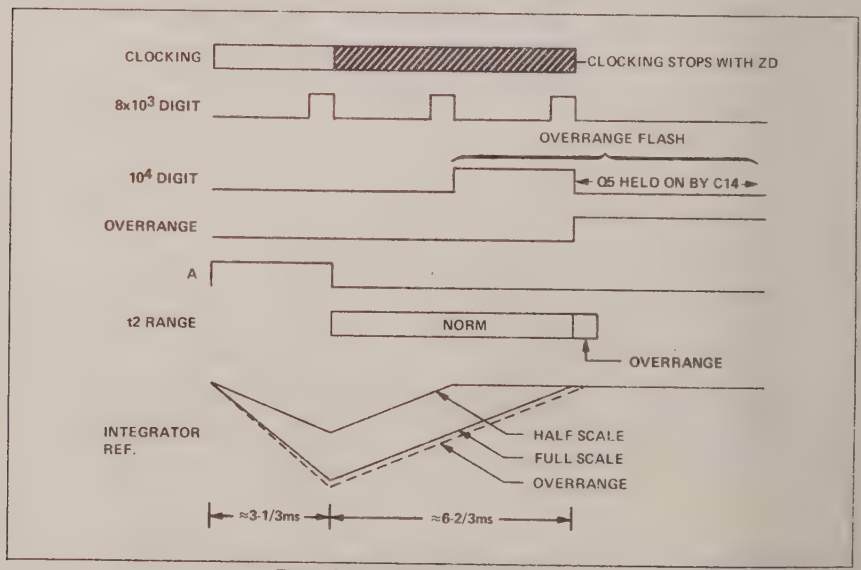


Figure 3-8. Counter Output Waveforms

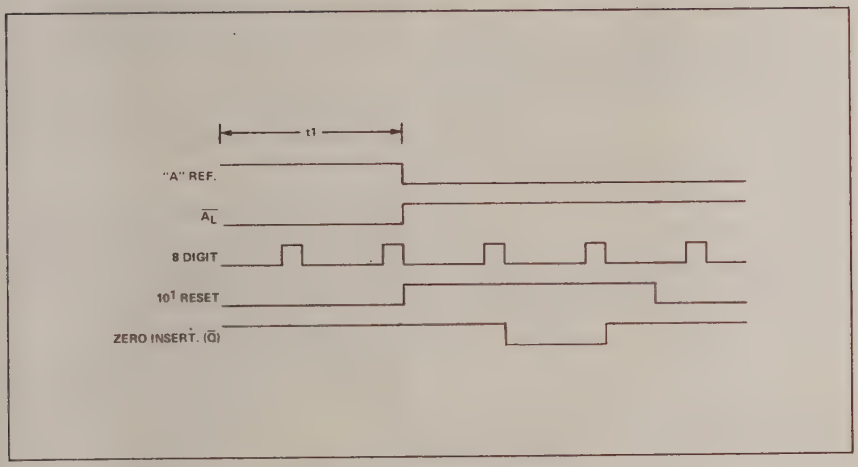


Figure 3-9. Zero Insertion Timing

3-31. Figure 3-9 shows input and output waveforms to the zero insertion flip-flop, as well as "A." Note that zero insert is a "0" for a 10 count duration 10 counts after t1 to 20 counts after t1.

3-32. Polarity (Figure 3-6)

3-33. The divide-by-two flip-flop is set to a "1" at reset time. "$\overline{A}$" is gated with the POLARITY output of the input amplifier. With negative polarities, the divide-by-two flip-flop is clocked to a "0" by "$\overline{A}$." For positive polarities, this clock is inhibited, and the flip-flop remains in the set state.

3-34. Reset Generator (Figure 3-10)

3-35. A15 is a programmable unijunction that turns ON when C2 charges to the trigger level established by program resistors R3 and R4. With A15 ON, C2 discharges through A15 and R7, turning A15 OFF. R5 and C2 determine the reset rate and are normally set for four to six conversions per second. The 60 Hz signal at the gate of A15 maintains synchronization with the line frequency. With the $\overline{HOLD}$ input grounded, A15 is held OFF.

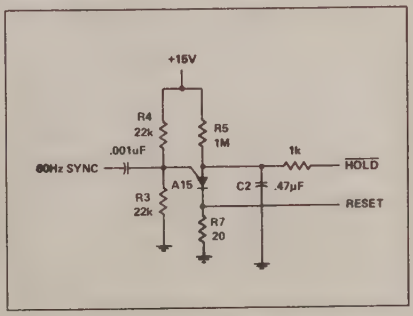


Figure 3-10. Reset Generator

3-36. DISPLAY CIRCUITRY

3-37. BCD to seven segment converters convert the counters BCD outputs to numbers that yield decimal lamp readouts. Figure 3-11 shows the circuitry for one decade and the plus, minus, and 10^4 digit circuit.

3-38. POWER SUPPLY (Figure 3-12)

3-39. ±15 Volt Supply

3-40. The ±15 volt supply employs two half-wave rectifiers into a silicon general incorporated model SG3501 integrated circuit regulator.

3-41. +5 Volt Supply

3-42. The +5 volt circuitry employs a full-wave rectifier and capacitance-input filter. Q22 of the regulator is biased ON with 5 volts on the base. With Q22 ON, Q21 turns ON. When the voltage at the collector of Q21 tries to exceed +5 volts, CR22 conducts, turning Q22 OFF sufficiently to maintain a +5 volt output.

3-42. With excessive output loads causing the output voltage to drop below 5 volts, CR23 conducts, turning Q21 and Q22 OFF.

3-43. +28 Volt Supply

3-44. The +28 volt supply employs a half-wave rectifier and capacitor input filter. Q24 controls the conduction of Q23. Since the conduction of Q24 is determined by R61 and R62, output variations produce corrective responses from Q24 and Q23.

3-45. With excessive current, the voltage drop across R60 biases Q25 into conduction. Q25 then takes base current from Q23, maintaining constant current through Q23.

3-46. +220 Volt Supply

3-47. The +220 volt supply employs only half-

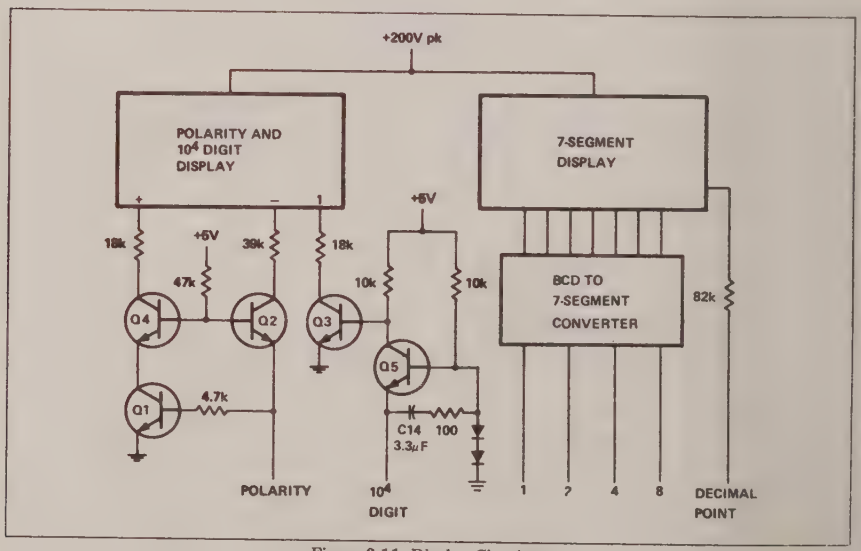


Figure 3-11. Display Circuitry

wave rectification. When the display is operated in dark environments, ionization instability occurs unless one of the display segments is maintained ionized. The bridge rectifier and capacitor input filter supplies ionization current. A decimal point provides the segment. When illumination is not desired, the current supplied does not provide a viewable luminance.

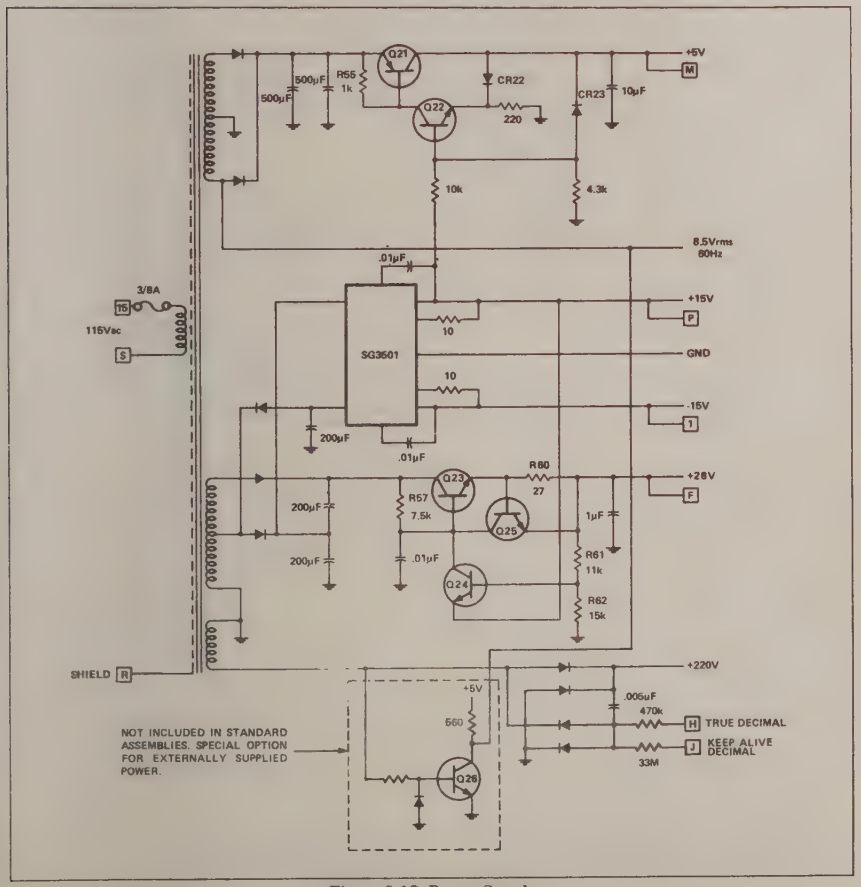


Figure 3-12. Power Supply

SECTION IV

CALIBRATION AND REPAIR

4-1. GENERAL

4-2. The accuracy of the meter should be established at 90 day intervals. Accuracy is confirmed when known inputs yield corresponding displays, within specified accuracy.

4-3. Test Equipment

4-4. Test equipment suitable for calibration or repair is specified in Table 4-1. Substitute equipment must be consistant with the required measurement accuracy.

Table 4-1. Test Equipment

Manufacturer	Description
Data Technology	Model 370 digital voltmeter
Fluke	Model 332A voltage standard
Fluke	Model 382A current standard
Tektronix	Type 545 oscilloscope with Type "W" preamplifier

4-5. CALIBRATION (Figure 4-1)

1. Remove the snap-on bezel.

2. Using the voltage standard for voltmeters and the current standard for ammeters, provide a zero level ANALOG INPUT.

3. Initiate 115 volts ac power ON and allow 20 minutes warm-up.

4. Adjust R9 until the polarity display toggles between "+" and "-." Turn R9 slightly clockwise until the "+" remains ON.

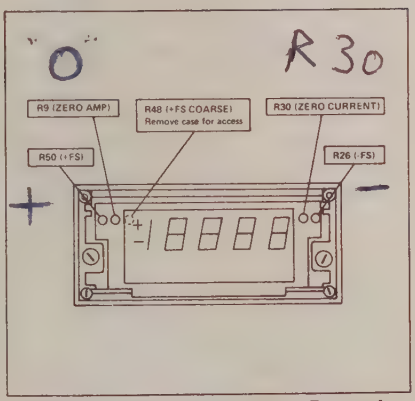


Figure 4-1. Meter Front With Bezel Removed Showing Calibration Potentiometers

5. Set the standard to the level which should yield a 0010 display. Adjust R30 for this display.

6. Return the standard to a zero level. Verify a display of 0000; if not, repeat steps 4 and 5.

7. Set the standard to a level which should yield a display midway between +19997 and +19998, and adjust R50 for a display that toggles between +19997 and +19998.

Note

If the display specified in step seven can not be attained, remove the meter from the case, and adjust R48 (+FS coarse). R48 is located directly to the right of R50 and R9.

8. Set the standard to a level which should yield a display midway between -19997 and -19998, and adjust R26 for a display that toggles between -19997 and -19998.

9. Repeat steps four through nine if necessary, nullifying any interaction of the adjustments.

4-6. REPAIR

Note

Before attempting any repairs, read the warranty provisions and conditions on page iii.

4-7. Section III of this manual devotes a paragraph to each functional block of the meter. Verify operation of these blocks using Section III.

CAUTION

When the case assembly must be removed, difficulty may be encountered in reassembling the unit. This difficulty is due to a taper in both the printed wire boards and the case slots provided for positioning these boards. The slots do not guide the boards into the case until a substantial portion of the board assembly is in the case. Misallignment of the boards is, therefore, likely unless care is taken. The recommended installation procedure is to position the case with the long meter face axis alligned vertically. Rest the boards in the lower slots and gradually slide the board assembly toward the rear of the case while maintaining board allignment with the upper slots. Very slight resistance is encountered with correct allignment. Do not force.

4-8. Factory Repair

4-9. Data Technology maintains a factory repair facility. Factory repairs seldom require more than a week. Experience shows factory repair of equipment to be best, and Data Technology urges customers to only attempt their own repairs when circumstances prevent the return of the meter to the factory. Refer to the customer service card inside the back cover for equipment return instructions.

SECTION V

SPECIAL MODIFICATIONS

(TO BE FILLED IN WHEN UNITS ARE MODIFIED)

DESCRIPTION OF MODIFICATION(S)

CHANGES IN SPECIFIED OPERATION(S)

DRAWINGS APPLICABLE TO MODIFICATION(S)

SECTION VI

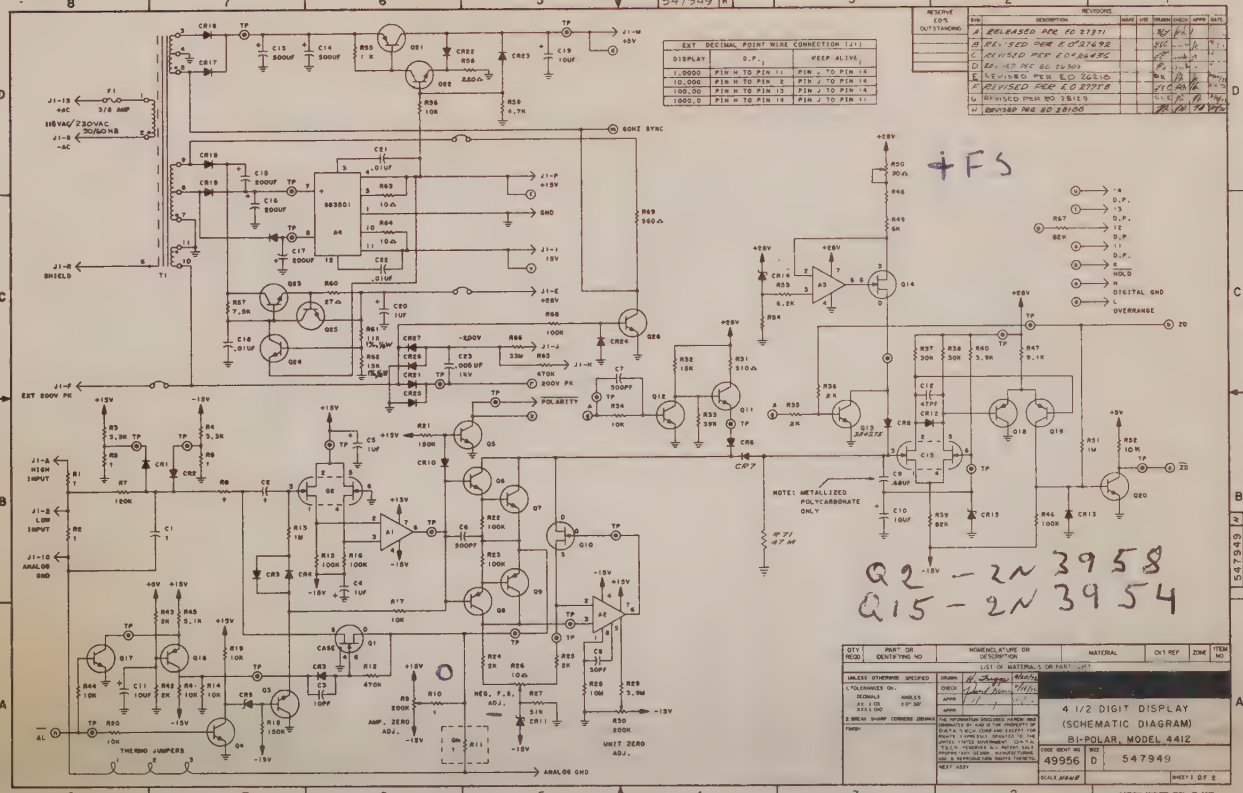
DRAWINGS AND PARTS LISTS

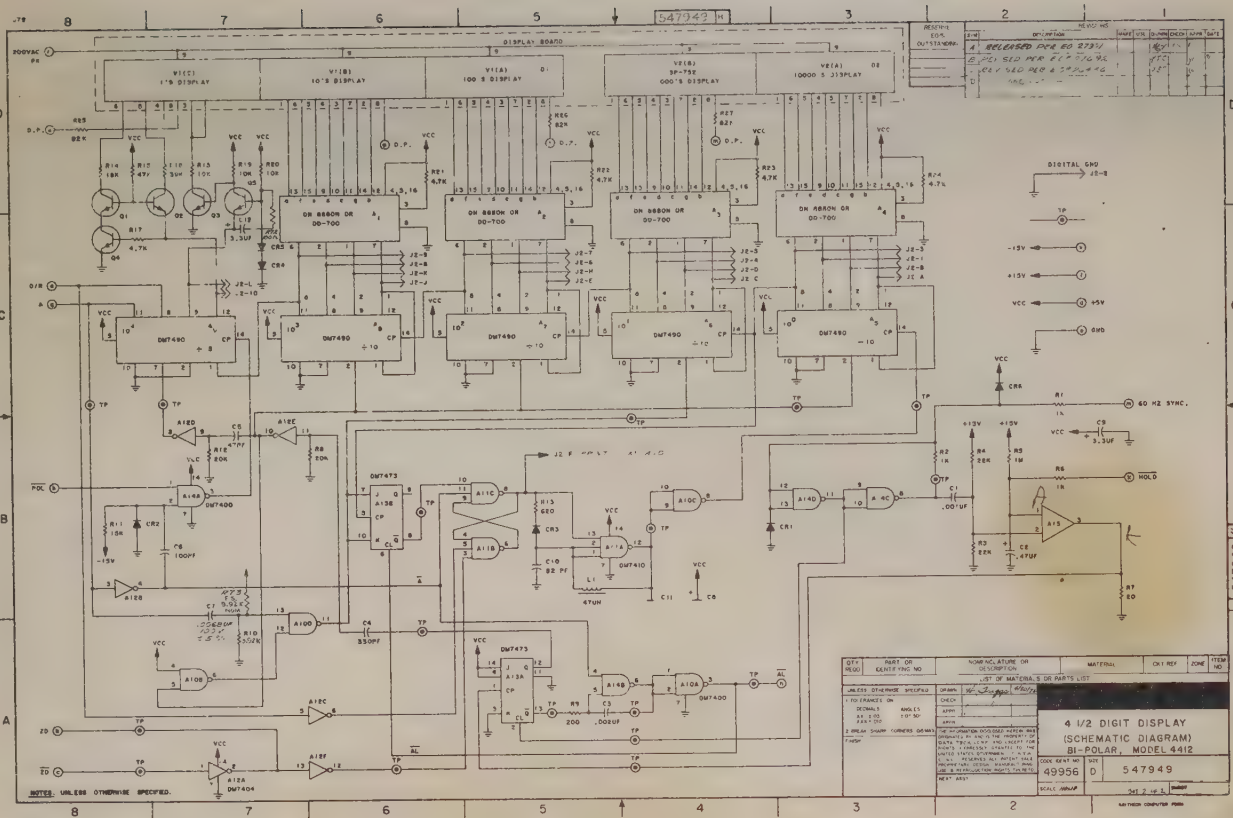
6-1. GENERAL

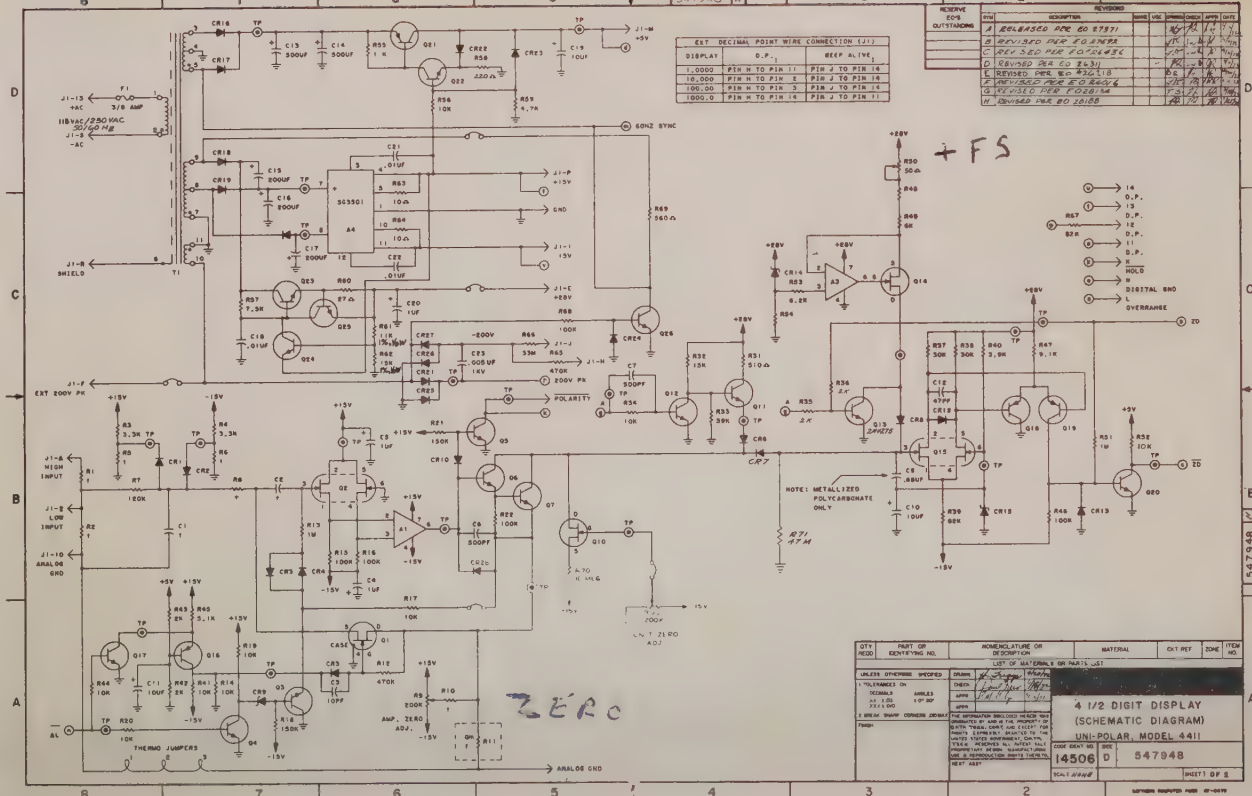
6-2. This section contains schematics, layout drawings, and parts lists for model 4411 and 4412 subassemblies.

6-3. DRAWINGS AND PARTS LISTS

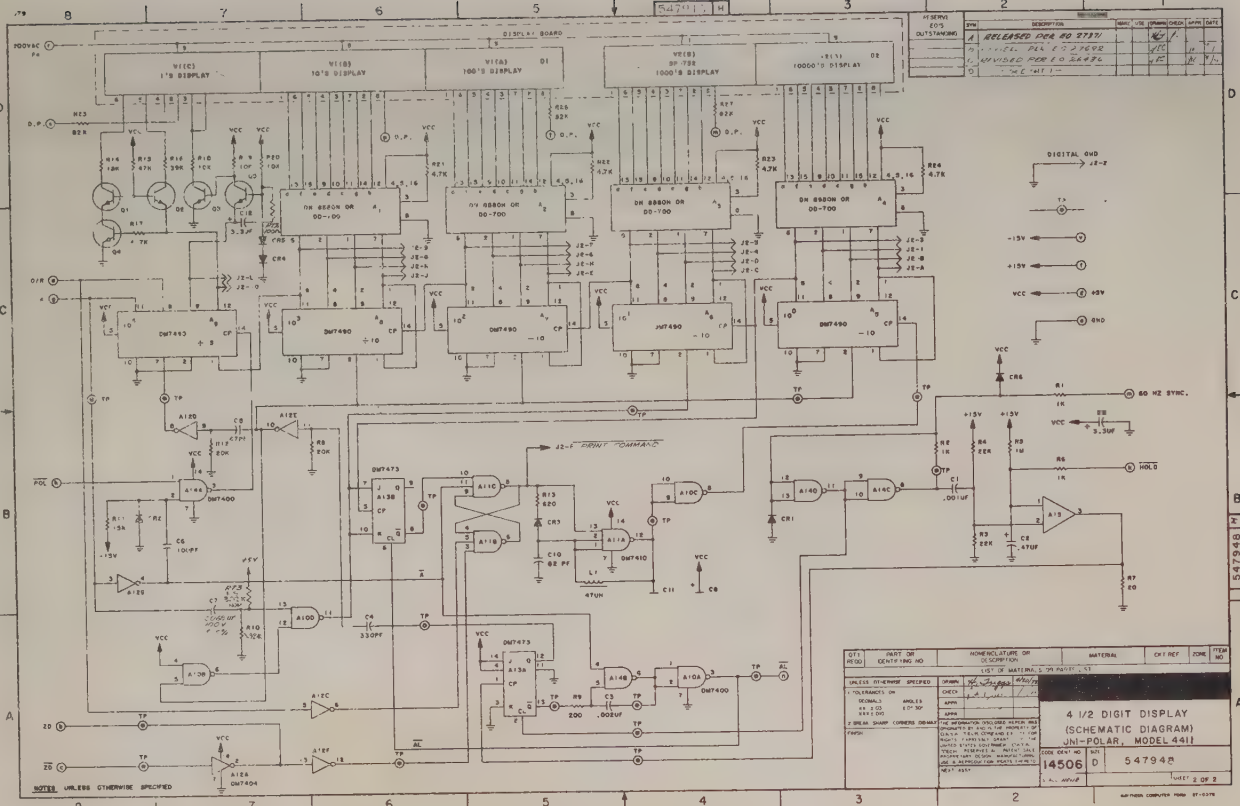
Drawing Number	Title
547949	4-1/2 Digit (Schematic Diagram) Bi-Polar, Model 4412
547948	4-1/2 Digit (Schematic Diagram) Uni-Polar, Model 4411
547844 page 3	Analog Board Assembly, 4-1/2 Digit, Model 4412 (Bi-Polar)
547844 S (ref)	Analog Board Assembly, Parts List (Bi-Polar)
547843 page 3	Analog Board Assembly, 4-1/2 Digit, Model 4411 (Uni-Polar)
547843 P (ref)	Analog Board Assembly, Parts List (Uni-Polar)
547841 page 2	Digital Board Assembly, 4-1/2 Digit, Model 4411 and 4412
547841 G (ref)	Digital Board Assembly, Parts List
547839	Display Board Assembly, 4-1/2 Digit, Model 4411 and 4412
547839 D (ref)	Display Board Assembly, Parts List

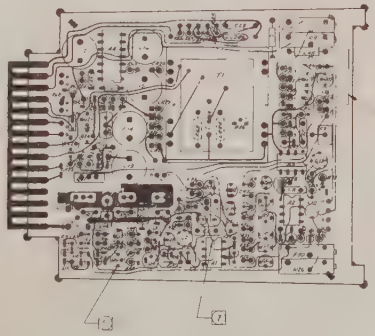

547949 H
EXT DECIMAL POINT WIRE CONNECTION (J1)
DISPLAY | D.P. | KEEP ALIVE
1.0000 | PIN H TO PIN 11 | PIN J TO PIN 14
10.000 | PIN H TO PIN 12 | PIN J TO PIN 14
100.00 | PIN H TO PIN 13 | PIN J TO PIN 14
1000.0 | PIN H TO PIN 14 | PIN J TO PIN 11
RESERVE FOR OUTSTANDING
REVISIONS
A RELEASED PER EO 27371
B RELEASED PER EO 27692
C REVISED PER EO 28435
D REVISED PER EO 28509
E REVISED PER EO 28216
F REVISED PER EO 27978
G REVISED PER EO 28109
H REVISED PER EO 28100
+FS
Q2 - 2N 3958
Q15 - 2N 3954
NOTE: METALLIZED POLYCARBONATE ONLY
4 1/2 DIGIT DISPLAY
(SCHEMATIC DIAGRAM)
BI-POLAR, MODEL 4412
CODE IDENT NO 49956
SIZE D
547949
SCALE NONE
SHEET 1 OF 2
4412 BI POLAR

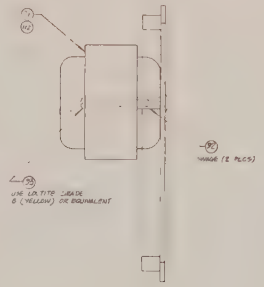

547949
DISPLAY BOARD
V1(C) 1'S DISPLAY
V1(B) 10'S DISPLAY
V1(A) 100'S DISPLAY
V2(B) 1000'S DISPLAY
V2(A) 10000'S DISPLAY
200VAC
D.P.
DIGITAL GND
+15V
VCC
+5V
GND
60 HZ SYNC.
HOLD
4 1/2 DIGIT DISPLAY
(SCHEMATIC DIAGRAM)
BI-POLAR, MODEL 4412
49956
547949
NOTES: UNLESS OTHERWISE SPECIFIED.



+ POLARITY ONLY


DISPLAY BOARD
DIGITAL GND
+15V
VCC
GND
60 HZ SYNC.
HOLD
4 1/2 DIGIT DISPLAY
(SCHEMATIC DIAGRAM)
JNI-POLAR, MODEL 441
547948
14506
SHEET 2 OF 2
NOTES UNLESS OTHERWISE SPECIFIED





REVISIONS			
ITEM	DESCRIPTION	DATE	APPROVED
	SEE SHEET 1		

547844

547844

QUANTITY PER ASSEMBLY	PARTS LIST
UNLESS OTHERWISE SPECIFIED	Data Technology Corporation
APPLICATION	ANALOG BD ASSY, 4 1/2 DIGIT, MODEL 4412 (BI-POLAR)
	SIZE D · DWG NO 14506 · REV K
	SCALE · SHEET 1 OF 2

Model 4412

Description Analog Board Assembly

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531986-001	R1 res. (20V, 200V, 1000V) 9.9M, 1%	03888	Pyrofilm PME70-T9-9.9M 1%				
531470-030	R2 res. (20V) 1.1M, 1%	03888	Pyrofilm PME60-T9-1.1M 1%				
531985-006	R2 res. (200V) 100k, 1%	07088	Kelvin				
531985-005	R2 res. (1000V) 10k, 1%	07088	Kelvin				
531985-004	R2 res. (200μA) 1k, 1%	07088	Kelvin				
531985-003	R2 res. (2mA) 100Ω, 1%	07088	Kelvin				
531985-001	R2 res. (200mA) 1Ω, 1%	07088	Kelvin				
531572-006	R2 res. (1000V) 10k, 10ppm, 1%	03888	Pyroflim PME55 Series				
531572-007	R2 res. (200V) 100k, 10ppm, 1%	03888	Pyrofilm PME55 Series				
503100-332	R3, 4 res. 3.3k, 1/4W, 5%	01121	Allen Bradley CB3325	09021	Airco Speer 4R332J		
503100-560	R5, 6 res. (200mA, 20mA, 2mA, 200μA 20μA, 2μA, 200mV) 56Ω, 1/4W, 5%	01121	Allen Bradley CB5605	09021	Airco Speer 4R560J		
503100-561	R5, 6 res. (1000V, 200V, 20V, 2V) 560Ω 1/4W, 5%	01121	Allen Bradley CB5615	09021	Airco Speer 4R561J		
503100-124	R7 res. 120k, 1/4W, 5%	01121	Allen Bradley CB1245	09021	Airco Speer 4R124J		
503100-563	R8 res. (200mV, 2V, 200V, 1000V, 2μA, 20μA, 200μA, 2mA, 20mA, 200mA) 56k, 1/4W, 5%	01121	Allen Bradley CB5635	09021	Airco Speer 4R563J		
503100-564	R8 res. (20V) 560k, 1/4W, 5%	01121	Allen Bradley CB5645	09021	Airco Speer 4R564J		
531866-015	R9, 30 res. 200k variable	73138	Beckman Instruments 88PR200K				

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-225	R10 res. (200mV, 2μA, 200μA, 2mA, 20mA, 200mA) 2.2M 1/4W, 5%	01121	Allen Bradley CB2255	09021	Airco Speer 4R255J		
503100-226	R10 res. (2V, 20V, 200V, 1000V) 22M 1/4W, 5%	01121	Allen Bradley CB2265	09021	Airco Speer 4R226J		
531984-001	R11 res. (2mA, 20mA, 200mA, 20mV, 2μA, 20μA, 200μA) 100Ω, .1%	05347	Ultronix Inc.				
531984-002	R11 res. (2V, 20V, 200V, 1000V) 1k, .1%	05347	Ultronix Inc.				
503100-474	R12, 66 res. 470k 1/4W, 5%	01121	Allen Bradley CB4745	09021	Airco Speer 4R474J		
503100-105	R13, 51 res. 1M 1/4W, 5%	01121	Allen Bradley CB1055	09021	Airco Speer 4R105J		
503100-103	R14, 17, 19, 20, 34, 41, 44, 52, 56 10k 1/4W, 5%	01121	Allen Bradley CB1035	09021	Airco Speer 4R103J		
503100-104	R15, 16, 22, 23, 46 res. 100k 1/4W, 5%	01121	Allen Bradley CB1045	09021	Airco Speer 4R104J		
503100-164	R18, 21 res. 160k 1/4W, 5%	01121	Allen Bradley CB1645	09021	Airco Speer 4R164J		
531984-003	R24, 25 res. 2k, 5ppm	05347	Ultronix Inc. Series 103A				
531866-001	R26 res. 10Ω, variable	73138	Beckman Instruments 89PR10				
503100-513	R27 res. 51k 1/4W, 5%	01121	Allen Bradley CB5135	09021	Airco Speer 4R513J		
503100-106	R28 res. 10M 1/4W, 5%	01121	Allen Bradley CB1065	09021	Airco Speer 4R106J		
503100-395	R29 res. 3.9M 1/4W, 5%	01121	Allen Bradley CB3955		Airco Speer 4R395J		
503100-511	R31 res. 510Ω 1/4W, 5%	01121	Allen Bradley CB5115	09021	Airco Speer 4R511J		

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-153	R32 res. 15k, 1/4W, 5%	01121	Allen Bradley CB1535	09021	Airco Speer 4R153J		
503100-393	R33 res. 39k, 1/4W, 5%	01121	Allen Bradley CB3935	09021	Airco Speer 4R393J		
503100-202	R35, 36, 42, 43 res. 2k, 1/4W, 5%	01121	Allen Bradley CB2025	09021	Airco Speer 4R202J		
503100-303	R37, 38 res. 30k, 1/4W, 5%	01121	Allen Bradley CB3035	09021	Airco Speer 4R303J		
503100-823	R39, 67 res. 82k, 1/4W, 5%	01121	Allen Bradley CB8235	09021	Airco Speer 4R823J		
503100-392	R40 res. 3.8k, 1/4W, 5%	01121	Allen Bradley CB3925	09021	Airco Speer 4R392J		
503100-512	R45 res. 5.1k, 1/4W, 5%	01121	Allen Bradley CB5125	09021	Airco Speer 4R512J		
503100-912	R47 res. 9.1k, 1/4W, 5%	01121	Allen Bradley CB9125	09021	Airco Speer 4R912J		
548301-201	R48 res. select in test (see CR14)	14506	Data Technology Corp. 548301-201				
531984-004	R49 res. 6k, 5ppm	05347	Ultronix Inc. Series 103A				
531866-003	R50 res. 50Ω, variable	73138	Beckman Instruments 89PR50	80294	Bourns Inc. 3006P-1-500		
503100-622	R53 res. 6.2k, 1/4W, 5%	01121	Allen Bradley CB6225	09021	Airco Speer 4R622J		
548401-201	R54 res. select in test (see CR14)	14506	Data Technology Corp. 548401-201				
503100-752	R57 res. 7.5k, 1/4W, 5%	01121	Allen Bradley CB7525	09021	Airco Speer 4R752J		
503100-221	R58 res. 220Ω, 1/4W, 5%	01121	Allen Bradley CB2215	09021	Airco Speer 4R221J		
503100-472	R59 res. 4.7k, 1/4W, 5%	01121	Allen Bradley CB4725	09021	Airco Speer 4R472J		

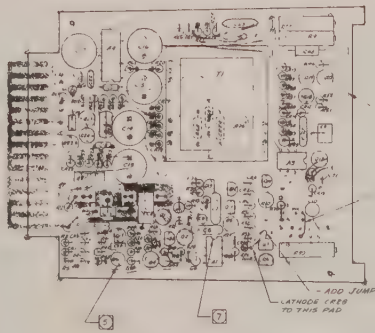
Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-270	R60 res. 27Ω, 1/4W, 5%	01121	Allen Bradley CB2705	09021	Airco Speer 4R270J		
531722-294	R61 res. 11k, 1/8W, 1%	28363	Corning Glass Works RN55D1102F	91637	Dale Electronics RN55D1102F		
531722-306	R62 res. 15k, 1/8W, 1%	28363	Corning Glass Works RN55D1502F	91637	Dale Electronics RN55D1502F		
503100-100	R63, 64 res. 10Ω, 1/4W, 5%	01121	Allen Bradley CB1005	09021	Airco Speer 4R100J		
503100-336	R66 res. 33M, 1/4W, 5%	01121	Allen Bradley CB3365	09021	Airco Speer 4R336J		
503100-104	R68 res. 100k, 1/4W, 5%	01121	Allen Bradley CB1045	09021	Airco Speer 4R104J		
503100-561	R69 res. 560Ω, 1/4W, 5%	01121	Allen Bradley CB5615	09021	Airco Speer 4R561J		
503100-476	R71 res. 47M, 1/4W, 5%	01121	Allen Bradley CB4765	09021	Airco Speer 4R476J		
531568-009	C1 cap. (20V) .01μF	14752	Electro-Cube 210B1B103	06739	Electron Corp. 2DE1-103		
531568-010	C1 cap. (200mV, 2V, 1000V, 20μA, 200μA) .1μF	14752	Electro-Cube 210B1B104	06739	Electron Corp. 2DE1-104		
817287-120	C1 cap. (200V, 2μA) .047μF	14752	Electro-Cube 210B1C473K				
531568-006	C2 cap. (200mV, 2V, 200V, 1000V, 2μA, 20μA, 200μA, 2mA, 20mA, 200mA) .22μF	14752	Electro-Cube 21B1C224K				
531568-012	C2, (20V) .022μF, 100V, ±20%	27556	IBM Electronic Products XA2B223				
531022-009	C3 cap. 10pF	71590	Centralab DD100				
532043-050	C4, 5, 20 cap. 1μF	14433	ITT Semi-Conductor TAG-.11-1.0/35-20				
531022-010	C6, 7 cap. 500pF	71590	Centralab DD501				

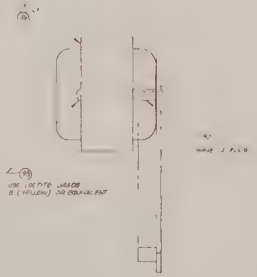
Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531022-011	C8 cap. 30pF	71590	Centralab DD300				
531784-002	C9 cap. .68μF	14752	Electra-Cube 625B1A684K				
531950-003	C10, 11, 19 cap. 10μF, 25V	22229	Union Carbide T360B106M025				
531022-012	C12 cap. 47pF	71590	Centralab DD470				
532026-003	C13, 14 cap. 470μF, 15V		Michicon R1-A16U470				
532026-001	C15, 17 cap. 220μF, 35V		Michicon R1-A35U220				
531022-005	C18, 21, 22 cap. .01μF	71590	Centralab CK-103				
818131-190	C23 cap. .005μF, 1kV	71590	Centralab DD-502				
818131-070	C24 cap. .002μF, 1kV	71590	Centralab DD-202				
531964-001	CR1-8 diode	13715	Fairchild Semi-Conductor FD300				
503176-006	CR9 diode	01295	Texas Isntruments 1N751A				
820284-010	CR10, 23, 13, 22, 23 diode	01295	Texas Instruments 1N4148	14433	ITT Semi-Conductor 1N4148		
817162-150	CR11 diode	12954	Dickson 1N753				
548401-201	CR14 diode, R48 res. R54 res. zener set (select in test)	14506	Data Technology Corp. 548401-201				

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503458-009	CR15 diode	04713	Motorola 1N965A				
503582-005	CR16 — CR21, 25, 26, 27 diode	04713	Motorola 1N4004	01295	Texas Instruments 1N4004		
820284-010	CR24 diode	01295	Texas Instruments 1N4148	14433	ITT Semi-Conductor 1N4148		
531975-001	Q1 transistor	07263	Fairchild Semi-Conductor 2N4220	01295	Texas Instruments 2N4220	04713	Motorola 2N4220
817340-010	Q2 transistor	22229	Union Carbide 2N3958				
531017-002	Q3, 11, 12 transistor	04713	Motorola 2N3904				
818956-010	Q4, 20 transistor	07263	Fairchild Semi-Conductor 2N5134				
817138-010	Q5, 24 transistor	07263	Fairchild Semi-Conductor 2N3565	27014	National Semi-Conductor 2N3565		
531976-001	Q6, 7 transistor	07263	Fairchild Semi-Conductor 2N5962				
531966-001	Q8 transistor	04713	Motorola 2N5087	07263	Fairchild Semi-Conductor 2N5087		
531772-001	Q9, 18, 19 transistor	07263	Fairchild Semi-Conductor 2N4250				
531785-001	Q10 transistor	16170	Teledyne Systems Co. U1899E				
531243-001	Q13 transistor	07263	Fairchild Semi-Conductor 2N4275				
821167-010	Q14 transistor	04713	Motorola MPF161				

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531842-001	Q15 transistor	07263	Fairchild Semi-Conductor 2N5138				
531979-001	Q16 transistor	32293	Intersil 2N3954				
822135-010	Q17 transistor	04713	Motorola 2N5220				
532025-001	Q21 transistor	01295	Texas Instruments TIP34				
818954-010	Q22 transistor	04713	Motorola 2N5088				
531982-001	Q23 transistor	04713	Motorola MPS-U05				
531841-001	Q25 transistor	07263	Fairchild Semi-Conductor 2N5133				
531841-001	Q26 transistor	07263	Fairchild Semi-Conductor 2N5133				
531948-001	A1 int ckt	27014	National Semi-Conductor LM307N				
531968-001	A2 int ckt	27014	National Semi-Conductor LM301AN				
818681-040	A3 int ckt	27014	National Semi-Conductor LM741CN				
531967-001	A4 int ckt	34333	Silicon General SC3501D				
531168-002	F1 fuse, 3/8A	79515	Little fuse 175.375				
531977-001	T1 transformer		Wood Transformers 7377A				
503048-022	J1-J3 Wire, 22 awg	92194	Alpha Wire Corp 298		National Wire & Cable Corp N1000-22		
547842-001	Analog Board	14506	Data Technology 547842-001				

SEE SHEET 1





547843

Data Technology Corporation

ANALOG BD ASSY, 4 1/2 DIGIT, MODEL 4411 (UNI-POLAR)

D 14506 547843

Model 4411

Description Analog Board Assembly

REPLACEABLE PARTS LIST

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531986-001	R1 res. (20V, 200V, 1000V) 9.9M, 1%	03888	Pyrofilm PME70-T9-9.9M 1%				
531470-030	R2 res. (20V) 1.1M, 1%	03888	Pyrofilm PME60-T9-1.1M 1%				
531985-006	R2 res. (200V) 100k, 1%	07088	Kelvin				
531985-005	R2 res. (1000V) 10k, 1%	07088	Kelvin				
531985-004	R2 res. (200μA) 1k, 1%	07088	Kelvin				
531985-003	R2 res. (2mA) 100Ω, 1%	07088	Kelvin				
531985-002	R2 res. (20mA) 10Ω, 1%	07088	Kelvin				
531985-001	R2 res. (200mA) 1Ω, 1%	07088	Kelvin				
531572-006	R2 res. (1000V) 10k, 10ppm, 1%	07088	Kelvin				
531572-007	R2 (200V) 100k, 10ppm, 1%	07088	Kelvin				
503100-332	R3, 4 res. 3.3k, 1/4W, 5%	01121	Allen Bradley CB3325	09021	Airco Speer 4R332J		
503100-560	R5, 6 res. (200mA, 20mA, 2mA, 200μA 20μA, 2μA, 200mV) 56Ω, 1/4W, 5%	01121	Allen Bradley CB5605	09021	Airco Speer 4R560J		
503100-561	R5, 6 res. (1000V, 200V, 20V, 2V) 560Ω 1/4W, 5%	01121	Allen Bradley CB5615	09021	Airco Speer 4R561J		
503100-124	R7 res. 120k, 1/4W, 5%	01121	Allen Bradley CB1245	09021	Airco Speer 4R124J		
503100-563	R8 res. (200mV, 2V, 200V, 1000V, 2μA, 20μA, 200μA, 2mA, 20mA, 200mA) 56k, 1/4W, 5%	01121	Allen Bradley CB5635	09021	Airco Speer 4R563J		
503100-564	R8 res (20V) 560k, 1/4W, 5%	01121	Allen Bradley CB5645	09021	Airco Speer 4R564J		

Drawing No 547843 P

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531866-015	R9, 30 res. 200k variable	73138	Beckman Instruments 89PR200k				
503100-226	R10 res. (2V, 200V, 1000V) 22M, 1/4W, 5%	01121	Allen Bradley CB2265	09021	Airco Speer 4R226J		
503100-225	R10 res. (200mV, 20V, 2μA, 20μA, 200μA, 2mA, 20mA, 200mA) 2.2M, 1/4W, 5%	01121	Allen Bradley CB2255	09021	Airco Speer 4R225J		
531984-001	R11 res. (2mA, 20mA, 200mA, 20mV, 2μA, 20μA, 200μA) 100Ω, 1%	05347	Ultronix Inc.				
531984-002	R11 res. (2V, 20V, 200V, 1000V) 1k, .1%	05347	Ultronix Inc.				
503100-474	R12, 65 res. 470k, 1/4W, 5%	01121	Allen Bradley CB4745	09021	Airco Speer 4R475J		
503100-105	R13, 51 res. 1M, 1/4W, 5%	01121	Allen Bradley CB1055	09021	Airco Speer 4R105J		
503100-103	R14, 17, 19, 20, 34, 41, 44, 52, 56 10k 1/4W, 5%	01121	Allen Bradley CB1035	09021	Airco Speer 4R103J		
503100-104	R15, 16, 22, 46 res. 100k, 1/4W, 5%	01121	Allen Bradley CB1045	09021	Airco Speer 4R104J		
503100-164	R18, 21 res. 160k, 1/4W, 5%	01121	Allen Bradley CB1645	09021	Airco Speer 4R164J		
503100-511	R31 res. 510Ω, 1/4W, 5%	01121	Allen Bradley CB5115	09021	Airco Speer 4R511J		
503100-153	R32 res. 15k, 1/4W, 5%	01121	Allen Bradley CB1535	09021	Airco Speer 4R153J		
503100-393	R33 res. 39k, 1/4W, 5%	01121	Allen Bradley CB3935	09021	Airco Speer 4R393J		
503100-202	R35, 36 42, 43 res. 2k, 1/4W, 5%	01121	Allen Bradley CB2025	09021	Airco Speer 4R202J		
503100-303	R37, 38 res. 30k, 1/4W, 5%	01121	Allen Bradley CB3035	09021	Airco Speer 4R303J		
503100-823	R39, 67 res. 82k, 1/4W, 5%	01121	Allen Bradley CB8235	09021	Airco Speer 4R823J		

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-392	R40 res. 3.9k, 1/4W, 5%	01121	Allen Bradley CB3925	09021	Airco Speer 4R392J		
503100-512	R45 res. 5.1k, 1/4W, 5%	01121	Allen Bradley CB5125	09021	Airco Speer 4R512J		
503100-912	R47 res. 9.1k, 1/4W, 5%	01121	Allen Bradley CB9125	09021	Airco Speer 4R912J		
531866-007	R48 res. 1k variable	73138	Beckman Instruments 89PR1K				
531984-004	R49 res. 6k, 5ppm	05347	Ultronix Inc. Series 103A				
531866-003	R50 res. 50Ω variable	73137	Beckman Instruments 89PR50	80294	Bourns Inc. 3006P-1-500		
503100-622	R53 res. 6.2k, 1/4W, 5%	01121	Allen Bradley CB6225	09021	Airco Speer 4R622J		
530692-103	R54 res. 10k, 2%	14574	Corning Glass Works Co. C4-103-2				
503100-752	R57 res. 7.5k, 1/4W, 5%	01121	Allen Bradley CB7525	09021	Airco Speer 4R752J		
503100-221	R58 res. 220Ω, 1/4W, 5%	01121	Allen Bradley CB2215	09021	Airco Speer 4R221J		
503100-472	R59 res. 4.7k, 1/4W, 5%	01121	Allen Bradley CB4725	09021	Airco Speer 4R472J		
503100-270	R60 res. 27Ω, 1/4W, 5%	01121	Allen Bradley CB2705	09021	Airco Speer 4R270J		
503100-113	R61 res. 11k, 1/4W, 5%	01121	Allen Bradley CB1135	09021	Airco Speer 4R113J		
503100-100	R63, 64 res. 10Ω, 1/4W, 5%	01121	Allen Bradley CB1005	09021	Airco Speer 4R100J		
503100-336	R66 res. 33M, 1/4W, 5%	01121	Allen Bradley CB3365	09021	Airco Speer 4R336J		
503100-104	R68 res. 100k, 1/4W, 5%	01121	Allen Bradley CB1045	09021	Airco Speer 4R104J		

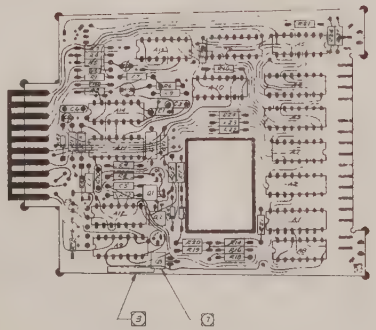
Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-561	R69 res. 560Ω, 1/4W, 5%	01121	Allen Bradley CB5615	09021	Airco Speer 4R561J		
503100-106	R70 res. 10M, 1/4W, 5%	01121	Allen Bradley CB1065	09021	Airco Speer 4R106J		
503100-476	R71 res. 47M, 1/4W, 5%	01121	Allen Bradley CB4765	09021	Airco Speer 4R476J		
531568-009	C1 cap. (2V) .01μF	14752	Electro-Cube 210B1B103	06739	Electron Corp. 1DE1-103		
531568-010	C1 cap. (200mV, 2V, 1000V, 20μA, 200μA, 2mA, 20mA, 200mA) .1μF	14752	Electro-Cube 210B1B104	06739	Electron Corp. 2DE1-104		
817287-120	C1 cap. (200V, 2μA) .047μF	14752	Electro-Cube 210B1C473K				
531568-006	C2 cap. (200mV, 2V, 200V, 1000V, 2μA, 20μA, 200μA, 2mA, 20mA, 200mA) .1μF	14752	Electro-Cube Series 210				
531568-012	C2 cap. (20V) .022μF, 100V, 20%	27556	IBM Electronic Products XA2B223				
531022-009	C3 cap. 10pF	71590	Centralab DD100				
532043-050	C4, 5, 20 cap. 1μF	14433	ITT Semi-Conductor TAG .11-1 .0/35-20				
531022-010	C6, 7 cap. 500pF	71590	Centralab DD501				
531784-001	C9 cap. .68μF	14752	Electra-Cube 625B1A684K				
531950-003	C10, 11, 19 cap. 10μF, 25V	22229	Union Carbide T360B106M025				
531022-012	C12 cap. 47pF	71590	Centralab DD470				

Drawing No 547843

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
532026-003	C13, 14 cap. 470μF, 15V		Michicon R1-A16U470				
532026-001	C15, 16, 17 cap. 220μF, 35V		Michicon R1-A35U220				
531022-005	C18, 21, 22 cap. .01μF	71590	Centralab CK103				
818131-190	C23 cap. .005μF, 1kV	71590	Centralab DD502				
818131-070	C24 cap. .002μF, 1kV	71590	Centralab DD202				
531964-001	CR1-8 diode	13715	Fairchild FD300				
503176-006	CR9 diode	01295	Texas Instruments 1N751A				
820284-010	CR10, 12, 13, 22, 23, 28 diode	01295	Texas Instruments 1N914	14433	ITT Semi-Conductor 1N914		
503458-009	CR15 diode	04713	Motorola 1N965B	07263	Fairchild 1N965B		
503582-005	CR21, 25, 26, 27 diode	04713	Motorola 1N4004	01295	Texas Instruments 1N4004		
820284-010	CR24 diode	01295	Texas Instruments 1N4148	14433	ITT Semi-Conductor 1N4148		
531975-001	Q1 transistor	07263	Fairchild Semi-Conductor 2N4220	01295	Texas Instruments 2N4220	04713	Motorola 2N4220
817340-010	Q2 transistor	22229	Union Carbide 2N3958				

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531017-002	Q3, 11, 12 transistor	04713	Motorola 2N3904				
818956-010	Q4, 20 transistor	07263	Fairchild Semi-Conductor 2N5134				
817138-010	Q5, 24 transistor	07263	Fairchild Semi-Conductor 2N3565	27014	National Semi-Conductor 2N3565		
531976-001	Q6, 7 transistor	07263	Fairchild Semi-Conductor 2N5962				
531785-001	Q10 transistor	16170	Teledyne Systems Co. U1899E				
821167-010	Q14 transistor	04713	Motorola MPF161				
531842-001	Q15 transistor	07263	Fairchild Semi-Conductor 2N5138				
531979-001	Q16 transistor	32293	Intersil 2N3954				
822135-010	Q17 transistor	04713	Motorla 2N5220				
531772-001	Q18, 19 transistor	07263	Fairchild Semi-Conductor 2N4250				
532025-001	Q21 transistor	01295	Texas Instruments TIP34				
818954-010	Q22 transistor	07263	Fairchild Semi-Conductor 2N5088				
531982-001	Q23 transistor	04713	Motorola MPS-U05				
531841-001	Q25 transistor	07263	Fairchild Semi-Conductor 2N5133				
531841-001	Q26 transistor	07263	Fairchild Semi-Conductor 2N5133				

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531948-001	A1 int ckt	27014	National Semi-Conductor LM307N				
818681-040	A3 int ckt	27014	National Semi-Conductor LM741CN				
531967-001	A4 int ckt	34333	Silicon General SG3501D				
531168-002	F1 Fuse, 3/8A	79515	Littlefuse 175.375				
531977-001	T1 transformer (115 Vac)		Profile Electronics, Inc. 1727-1				
531977-002	T1 transformer (230 Vac)		Profile Electronics, Inc. 1727-2				
503048-022	J1-J4 Wire, 22 awg	92194	Alpha Wire Corp. 298		National Wire & Cable Corp. N1000-22		
531736-002	J5 Wire, 22 awg	90484	ITT Wire & Cable Div. WTE24A				
547842-001	Analog Board	14506	Data Technology 547842-001				



547841

TYP FOR Q1, Q2 *Q3
(BEND AT RIGHT ANGLES)

.100 (2 OUTSIDE LEADS)

.150 (CENTER LEAD)

DETAIL A
SCALE: NONE

3 R73 MAY BE CHANGED IN TEST

2 ALL COMPONENTS ARE TO BE AS CLOSE TO BOARD AS POSSIBLE

6 SOLDER HEIGHT NOT TO EXCEED 0.030 INCH.

5 NOTCH ON I.C. UNIT INDICATES PIN 1.

4 BAND ON DIODES INDICATES CATHODE END.

3 IDENTIFY PER DATA TECH SPEC 505753

2 SQUARE PADS INDICATE CATHODE END OF DIODES, POSITIVE SIDE OF POLARIZED CAPACITORS, EMITTERS OF TRANSISTORS, AND PIN 1 OF I.C. UNITS.

1. REFERENCE SCHEMATIC DIAGRAM 547949

NOTES: UNLESS OTHERWISE SPECIFIED

10	09	-08	-07	06	-05	-04	-03	-02	-01	ITEM	PART NO	COMP. OR SYS. NO	DESCRIPTION	REVISIONS

QUANTITY PER ASSEMBLY

UNLESS OTHERWISE SPECIFIED
INTERPRET PER MIL-D-1000
REMOVE BURRS AND SHARP EDGES
APPLY SOLDER RESIST COATING
APPLY BEFORE PLATING OR COATING
COMMERCIAL TOLERANCES APPLY TO
BLOCK'S DATA
DO NOT SCALE THIS PRINT

TOLERANCES
DECIMALS ANGLES

10	09	-08	-07	06	-05	-04	-03	-02	-01	ITEM	PART NO	COMP. OR SYS. NO	DESCRIPTION	REVISIONS

PARTS LIST

10	09	-08	-07	06	-05	-04	-03	-02	-01	ITEM	PART NO	COMP. OR SYS. NO	DESCRIPTION	REVISIONS

547933
547934

10	09	-08	-07	06	-05	-04	-03	-02	-01	ITEM	PART NO	COMP. OR SYS. NO	DESCRIPTION	REVISIONS

APPLICATION

DRAWN
CHECKED
ENGR APPR.
MFG APPR.
QUALITY APPR.
PROJECT MGR.
DRAFTING SUPV.

Data Technology Corporation
1050 East Meadow Circle Palo Alto, California 94303

TITLE
DIGITAL BD ASSY
9 1/2 LNSLT
MODEL 4412/4422

SIZE D | CODE IDENT NO. 14506 | DRAWING NO.

SCALE 8/1 | SHEET 1 OF 1

Model 4411 and 4412

Description Digital Board Assembly

REPLACEABLE PARTS LIST

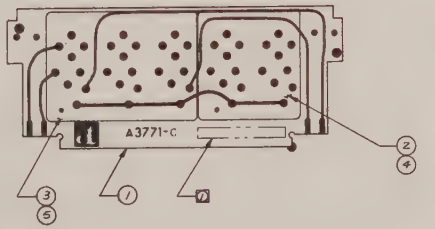
Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-102	R1, 2, 6 res. 1k, 1/4W, 5%	01121	Allen Bradley CB1025	09021	Airco Speer 4R102J		
503100-223	R3, 4 res. 22k, 1/4W, 5%	01121	Allen Bradley CB2235	09021	Airco Speer 4R233J		
503100-105	R5 res. 1M, 1/4W, 5%	01121	Allen Bradley CB1055	09021	Airco Speer 4R105J		
503100-200	R7 res. 200Ω, 1/4W, 5%	01121	Allen Bradley CB2005	09021	Airco Speer 4R200J		
503100-203	R8, 12 res. 20k, 1/4W, 5%	01121	Allen Bradley CB2035	09021	Airco Speer 4R203J		
503100-201	R9 res. 200Ω, 1/4W, 5%	01121	Allen Bradley CB2015	09021	Airco Speer 4R201J		
531722-251	R10 res. 3.92k, 1%	14674	Corning Glass Works RN55D3921F	91637	Dale Electronics Co. RN55D3921F		
503100-153	R11 res. 15k, 1/4W, 5%	01121	Allen Bradley CB1535	09021	Airco Speer 4R153J		
503100-621	R13 res. 620Ω, 1/4W, 5%	01121	Allen Bradley CB6215	09021	Airco Speer 4R621J		
503100-183	R14, 18 res. 18k, 1/4W, 5%	01121	Allen Bradley CB1835	09021	Airco Speer 4R183J		
503100-473	R15 res. 47k, 1/4W, 5%	01121	Allen Bradley CB4735	09021	Airco Speer 4R473J		
503100-393	R16 res. 39k, 1/4W, 5%	01121	Allen Bradley CB3935	09021	Airco Speer 4R393J		
503100-472	R17, 21 — 24 res. 4.7k, 1/4W, 5%	01121	Allen Bradley CB4725	09021	Airco Speer 4R472J		
503100-103	R19, 20 res. 10k, 1/4W, 5%	01121	Allen Bradley CB1035	09021	Airco Speer 4R103J		

Drawing No 547841 G

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
503100-823	R25, 26, 27 res. 82k, 1/4W, 5%	01121	Allen Bradley CB8235	09021	Airco Speer 4R823J		
503100-101	R72 res. 100Ω, 1/4W, 5%	01121	Allen Bradley CB1015	09021	Airco Speer 4R101J		
531722-251	R73 res. 3.92k, nom	14674	Corning Glass Works RN55D3921F	91637	Dale Electronics RN55D3921F		
531388-006	C1 cap. .001μF	56289	Sprague C023B102E102M				
531950-001	C2 cap. .47μF	22229	Union Carbide T360A335M015AS	56289	Sprague 196D474X0035HA1	12954	Dickson DR47GSA35M
531022-007	C3 cap. .0022μF	71590	Centralab DD222				
530758-331	C4 cap. 330pF	04222	Aerovox Corp. MC71B331AK	56289	Sprague 26C075331X9101C		
531022-008	C6 cap. 100pF	71590	Centralab DD101				
531568-011	C7 cap. .0068μF	27556	IBM Electronic Products XA7B682J	14752	Electric Cube 210B1B682J		
818337-040	C8, 9, 12 cap. 3.3μF	22229	Union Carbide K3R3E15				
817279-210	C10 cap. 82pF	72136	Electro Motive Mfg. Co. CM15E820J				
530758-471	C11 cap. 470pF	04222	Aerovox Corp. MC71B471AK	56289	Sprague 262C07541X9101C		
820284-001	CR1-6 diode	01295	Texas Instruments IN4148 or IN914	14433	ITT Semi-Conductor IN4148 or IN914	07910	Continental Device IN4148 or IN914
531952-001	Q1, 2, 3 transistor	04713	Motorola 2N5550	07263	Fairchild Semi-Conductor 2N5550		
531841-001	Q4, 5 transistor	07263	Fairchild Semi-Conductor 2N5133				
531938-001	A1-4 int ckt	27014	National Semi-Conductor DM8880N	07187	Sperry Information Displays Division DD-700		

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
814951-010	A5-9 int ckt	27014	National Semi-Conductor DM7490	01295	Texas Instruments SN7490AN		
531359-003	A10, 14 int ckt	27014	National Semi-Conductor DM7400N	04713	Motorola MC7400P	56289	Sprague MSN7400A
531359-004	A11 int ckt	27014	National Semi-Conductor DM7410	04713	Motorola MC7410P	01295	Texas Instruments SN7410N
531359-013	A12 int ckt	04713	Motorola MC7404P	01295	Texas Instruments SN7404N	56289	Sprague SN7404N
820332-010	A13 int ckt	01295	Texas Instruments SN7473N				
531945-001	A15 int ckt	04713	Motorola MPU-131				
531958-473	L1 coil, 47μH	99800	Delevan Electric Corp. 1025-60				
547840-001	Digital Board	14506	Data Technology 547840-001				

REVISIONS			
SYM	DESCRIPTION		
A	RELEASED PER E.O. 26860	9/18/72	PD
B	REVISED PER E.O. 27183	12/28/72	MJ
C	REVISED PER EO 27871	4/23/73	TG
D	REVISED PER EO 28036	9/28/73	JL



547839
REV D

ITEM	PART NO	CODE IDENT NO	DESCRIPTION	REMARKS
1	5	531940-002	SOCKET, 3 1/2 DIGIT, CS753	XV2
1	4	531940-001	SOCKET, 2 DIGIT, CS752	XV1
1	3	531941-002	DISPLAY, 3 1/2 DIGIT, SP152	V2
1	2	531942-001	DISPLAY, 2 DIGIT, SP752	V1
1	1	547838-001	DISPLAY BOARD	—

-70 -60 -50 -40 -30 -20 -10

QUANTITY PER ASSEMBLY

PARTS LIST

UNLESS OTHERWISE SPECIFIED

INTERPRET PER MIL D 1000
REMOVE BURRS AND SHARP EDGES
DIMENSIONS ARE IN INCHES AND APPLY BEFORE PLATING OR COATING.
COMMERCIAL TOLERANCES APPLY TO STOCK SIZES
DO NOT SCALE THIS PRINT

TOLERANCES

	1 PLACE	2 PLACE	ANGLE
	±.1	±.01	±1°

	ALL HOLES DIAMETERS							
UNDER	.062	.125	.250	.500	.750	1.000	2.000	3.000
±	.005	.005	.005	.005	.010	.010	.015	.015
	.002	.001	.001	.001	.001	.001	.001	.001

	DATE
DRAWN	9/28/73
CHECKED	9/28/73
APPROVED	9/28/73
APPROVED	
APPROVED	
RELEASE DATE	
REVD HARDWS	
HEAT TREAT	

Data Technology Corporation
1050 East Meadow Circle Palo Alto, California 94303

TITLE: DISPLAY BOARD ASSY, 4 1/2 DIGIT, MODEL 4411 AND MODEL 4412

SIZE	CODE IDENT NO	DRAWING NO	REV
C	14506	547839	D

SCALE 3/1 CONTRACT NO SHEET 1 OF 1

BASE NO	NEXT ASSEMBLY	NEXT	TOTAL
USED ON		QUANTITY	

APPLICATION

546120

2. REFERENCE SCHEMATIC DIAGRAM 547949.
☑ IDENTIFY PER DATA TECH SPEC 505753.
NOTES: UNLESS OTHERWISE SPECIFIED.

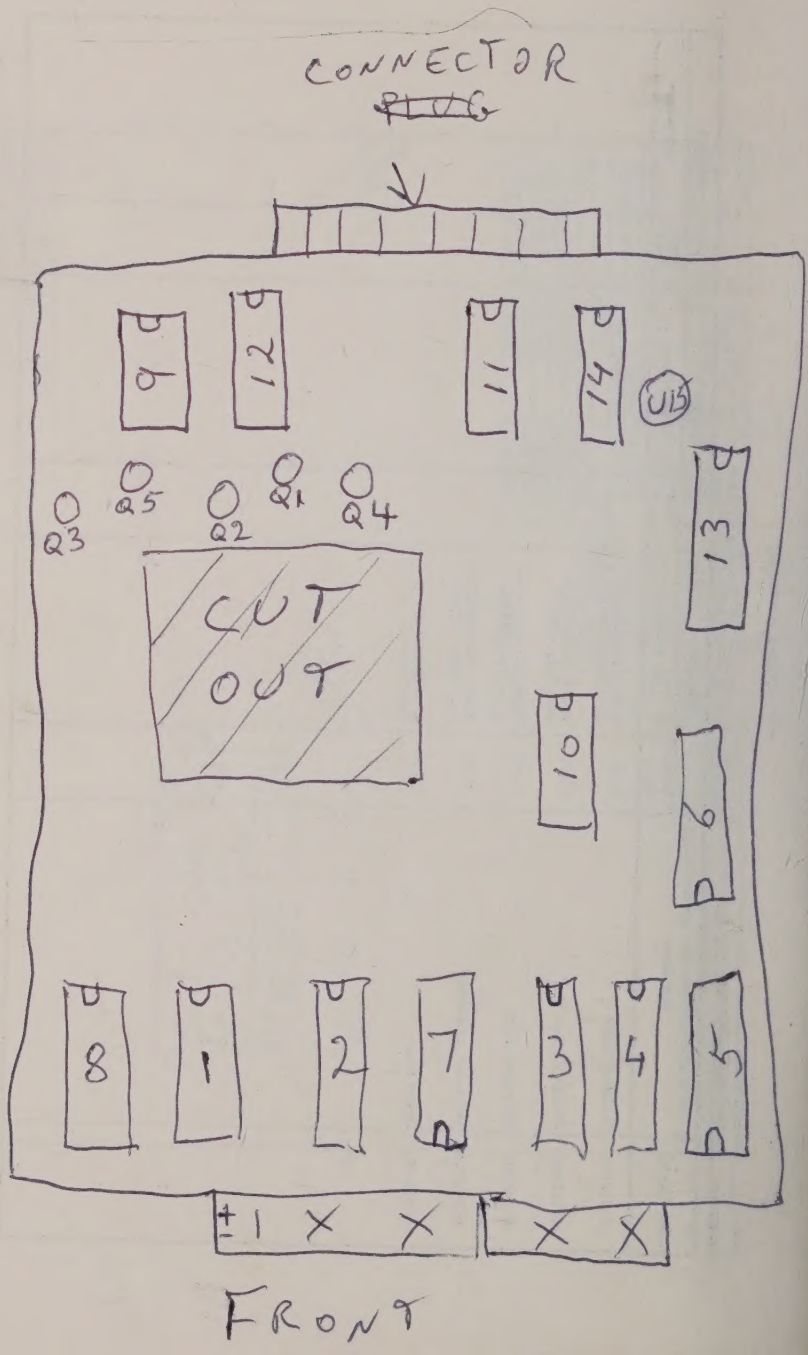
REPLACEABLE PARTS LIST

Model 4411 and 4412

Description Display Board Assembly

Data Tech No	Description	Source 1		Source 2		Source 3	
		Code Ident	Mfg & Type	Code Ident	Mfg & Type	Code Ident	Mfg & Type
531942-001	V1 display, 2 digit	07187	Sperry Information Displays Division SP752				
531941-002	V2 display, ±2-1/2 digit	07187	Sperry Information Displays Division SP152				
531940-001	XV1 socket, 2 digit	07187	Sperry Information Displays Division CS752				
531940-002	XV2 socket, ±2-1/2 digit	07187	Sperry Information Displays Division CS753				
547838-001	Display Board	14506	Data Technology 547838-001				

Drawing No 547839 D


CONNECTOR
PLUG
9
12
11
14
U13
Q5
Q1
Q4
Q3
Q2
13
CUT
OUT
10
6
8
1
2
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+
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FRONT

MP MASTER

MA25741

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